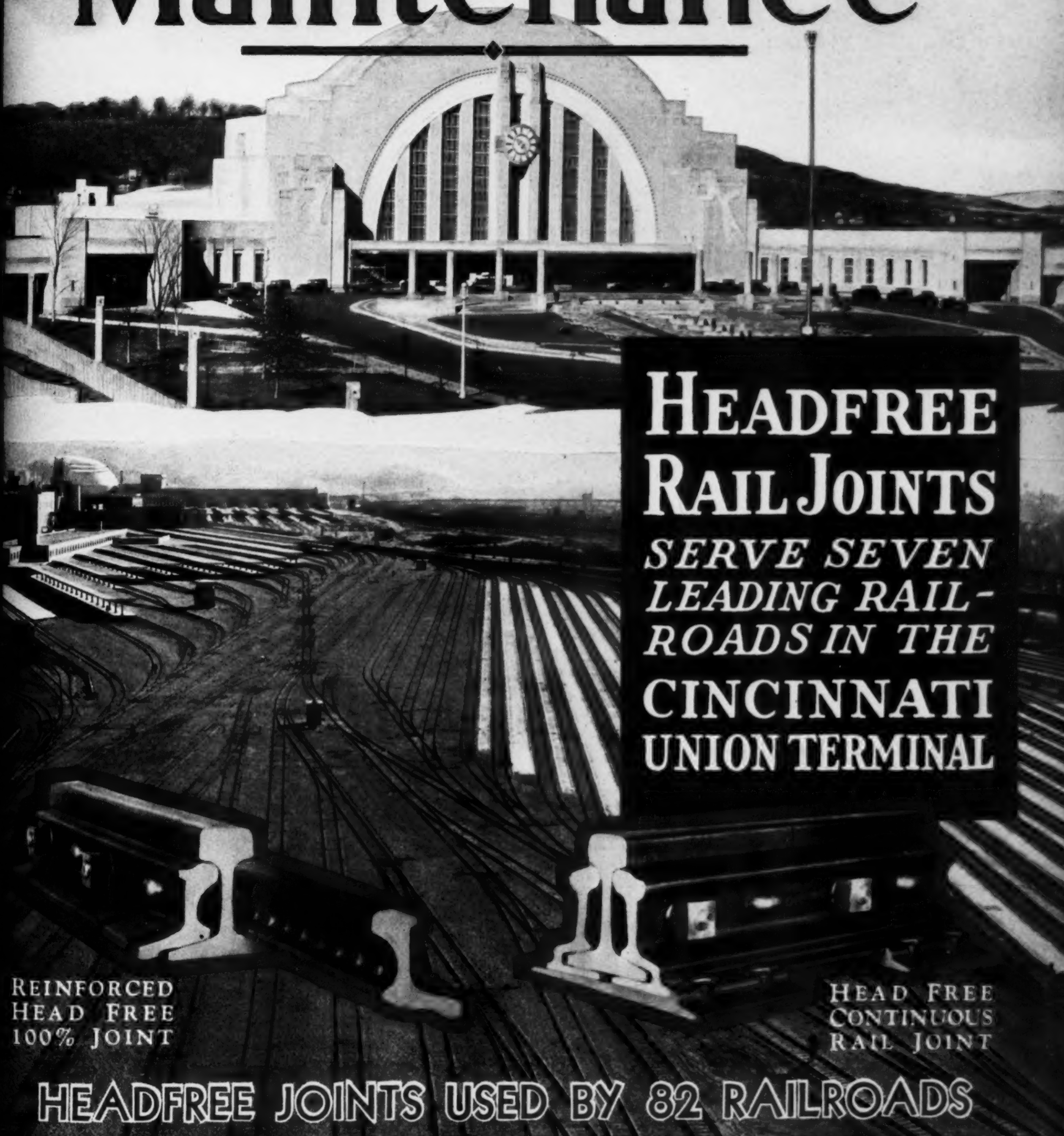
May, 1933

Railway Engineering and Maintenance



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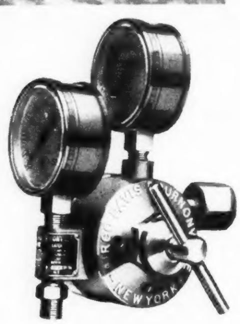

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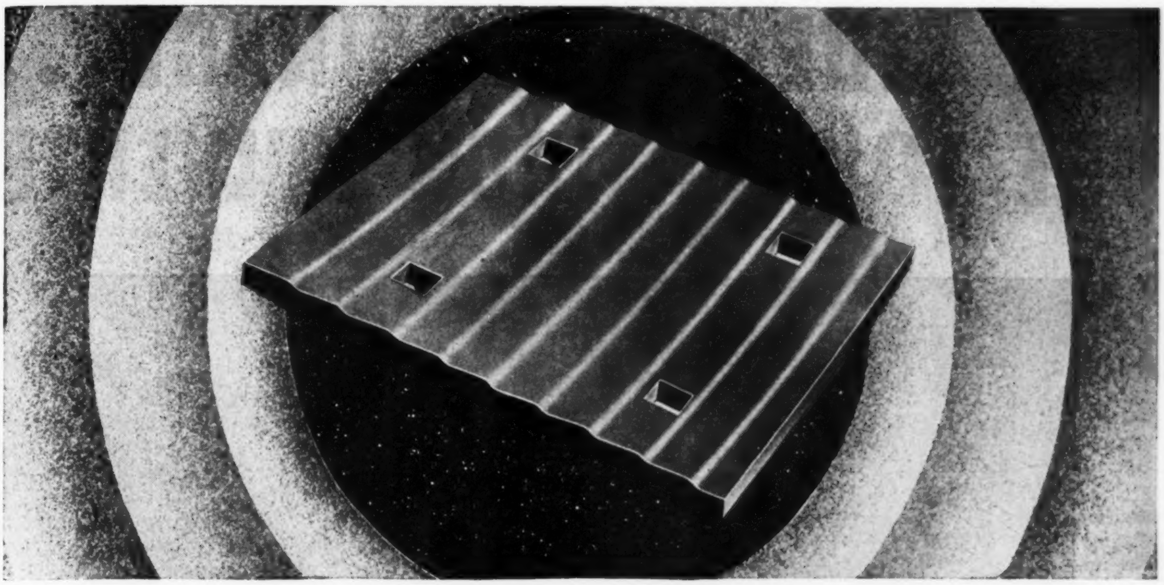

FOR SIDE-HILL DRAINAGE...
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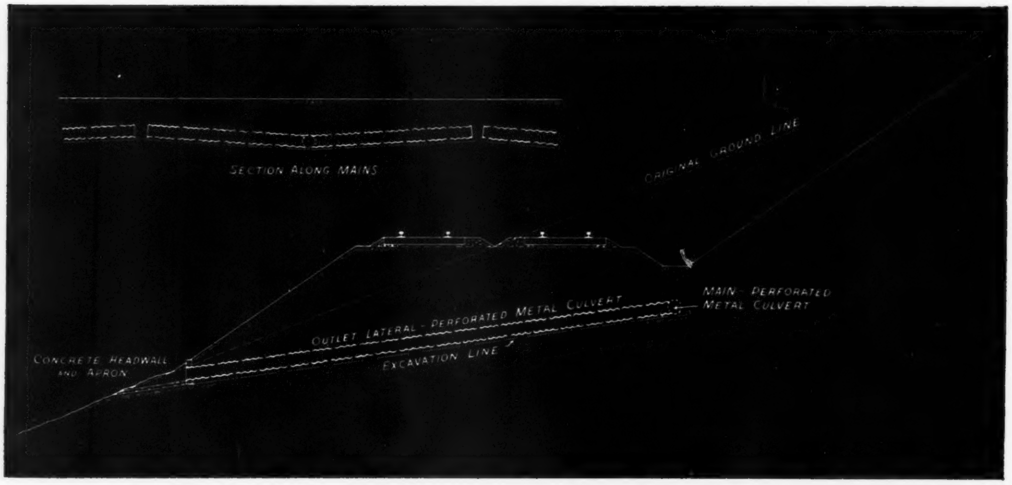

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No. 53 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: THE HITCH HIKER

April 27, 1933.

Dear Reader:

While on a short auto trip last summer, I was impressed with the number of hitch hikers "thumbing" their way about the country. Since that time, I have thought frequently of this modern parasite on the highway. He makes no investment in a car, he assumes no responsibility for driving, he does not even share the cost of the gasoline. In other words, he travels from place to place entirely at the expense of others.

The term is a new one, born of the automobile. Yet the attitude which it characterizes is as old as the hills, for there always have been those who, while unwilling to share the cost, demand participation in the benefits.

In railway circles, it would seem to include those employees who do nothing to aid the railways in overcoming the unjust handicaps to which they are subjected in their competition with buses and trucks, yet expect to participate in the increased employment that will result from the return of this traffic to the rails. A similar attitude may be attributed to those companies which sell to the railways but which exert no effort to correct the competitive conditions which will permit the roads to re-enter the markets for supplies.

It has even occurred to me that in these days when railway and railway supply men alike are looking more intently than ever before to publications like Railway Engineering and Maintenance for information regarding new methods, new materials and equipment, and changes in personnel, they may be hitch hiking when they allow their subscriptions to lapse and read the copies of fellow employees.

Yes, hitch hiking is a nation-wide practice in these days. It is, however, none the less of a burden on those whose "gasoline" is being consumed. I wonder if you have ever thought, as I have been thinking of late, of the many ways in which all of us are hitch hiking in these days when we should be "paying our share of the gas."

Yours sincerely,

Elmer T. Howson

Editor.

ETH*JC

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Railway Engineering and Maintenance

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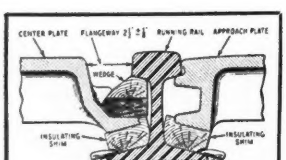

Section showing how Racor Crossings are supported by the track rail to maintain a constant level.

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Railway Engineering and Maintenance

THE HAZARD

Is Highway or Air Travel as Safe as Rail?

IN these days when the supremacy of the railways as passenger-carrying agencies is being challenged so aggressively by both highway bus operators and aviation companies, and when the security of employment of those in the maintenance of way and other branches of railway service is being jeopardized more and more by the inroads that these agencies are making on railway revenues, it is to the personal interest of every employee of the railways to acquaint himself with every advantage adhering to travel by rail and to give this information the widest possible dissemination.

Travel by rail is superior to that by highway or air in many respects, including comfort of accommodations, dependability of service, reliability of carrier, etc. Nowhere, however, is this superiority greater than with respect to safety. Here the railways have established and are maintaining as every-day routine a record which these competing agencies do not even approach.

The Railways' Record

Take, for example, the record for 1932, the preliminary figures for which have just been made public by the Interstate Commerce Commission. In this year, during which the railways of the United States carried 480 million passengers a total of 33,562 *million* passenger miles, only *one* passenger was killed in a train accident and this passenger was a railroad employee off duty riding in a motor car which collided with another train. Including train service accidents (or those occurring in the movement of trains where there is no collision or derailment) there were only 23 deaths among passengers last year. If there be included also all non-train accidents, the total number of passengers killed last year was only 28.

Consider for a moment what this record means. Expressed in one way, it means that one could travel around the earth at the place of its greatest circumference—the equator—more than one and a third *million* times before meeting death in a passenger train. Again, it means that if one were to travel at the rate of 60 miles per hour, day in and day out, with no interruptions for meals or other causes, he would continue for more than 63,000 years before being killed in a train accident. Or, even if train service and non-train accidents were included, a passenger would travel almost 2300 years before meeting death on a railway train.

Nor is this record, remarkable as it is, an unusual one, for in 1931, a year in which 25 per cent more passengers were handled by the railways, only four passengers met death in train accidents and in the five years preceding 1932, with greatly increased traffic, the number of passengers killed in train accidents averaged less than 15. Likewise, the number of passengers killed in railway accidents—train, train service and non-train—in these five years averaged only 72 or less than one per *ten million* passengers carried.

In the Air

How does this compare with travel by air? Statistics compiled by the Aeronautics Bureau of the United States Department of Commerce show that 25 passengers met death while traveling on airplanes flying in scheduled operations last year. This was equivalent to one death for every 5,800,000 passenger miles flown. In other words, not only were there 25 times as many passengers killed in airplane accidents in regular scheduled service as in railway train accidents last year, but, giving consideration to the far smaller number of passengers carried by air, the hazard was 5,600 times as great. And these figures omit the large number of accidents to those riding in airplanes in other than regular commercial operation on scheduled routes.

On the Highways

The record on the highways is still more appalling. Here it is impossible to so break down the statistics as to segregate the deaths arising from accidents to passengers traveling in buses in common carrier service from those occurring as the result of the operation of other highway vehicles. It is known, however, that more than 30,000 persons have been killed annually in highway accidents of all kinds in recent years and that even with the reduced traffic of last year, the number exceeded 29,500, to say nothing of the more than a million other persons who were injured. In other words, the deaths from highway accidents average more than 80 every day of the year. That the buses exact their full share of this toll of human life is self-evident.

The Contrast

Such a contrast is of vital importance to those who travel only occasionally as well as to those who travel almost daily. Yet they give little thought to it. They have so long been accustomed to such complete safety

of travel by rail, made possible by years of constant training of employees in careful methods of operation, that they give little thought to the hazard when turning to other methods of transportation where no such standards prevail.

Until such time as competing agencies select their employees with extreme care, subject them to long training in subordinate positions, require regular physical examinations, limit their hours of work, draft and enforce rules to insure safety in action and adopt those other measures necessary to eliminate hazard, the railways will continue to excel in safety of transportation. So long as they do, railway employees should very properly emphasize this fact at every opportunity—an action which will not only result to the benefit of the railways, but will conserve human life as well.

A NEW PROBLEM

The Highway Crossing Assumes Importance

THE highway crossing is in a process of evolution. It can no longer be regarded as a minor detail but is rapidly assuming a position of importance in the routine of the maintenance of way man. This is shown clearly in a survey of present practice with respect to this subject which appears on page 226 of this issue.

Several facts stand out prominently in this survey. One is that the plank crossing is still the most extensively used form of construction. Another is that it is widely regarded as no longer meeting present-day demands of service and of economy of maintenance. A third conclusion that is equally evident from this survey is that railway men have not yet arrived at any common decision as to the most desirable form of construction. All of the various substitutes for plank—treated timber, rock asphalt, bituminous concrete of both the penetration and pre-mixed forms, asphalt plank, armored or old-rail construction, concrete of both precast slab and monolithic designs, and metal—have their advocates, although some of these types are more widely favored than others. Here and there a road has, at least tentatively, adopted some one design as its standard, but there is little unanimity in this respect among even these roads. Rather, most railway officers are today of an inquiring mind with respect to highway crossing construction.

Still another conclusion to be drawn from this survey is the fact that no one standard will suffice for all roads or even for all conditions on a single road. Instead, it is coming to be recognized that it is equally as uneconomical to install a less permanent form of construction in a highway of dense traffic as it is to place one of the more expensive types in a farm road crossing. Each type of crossing has its place just as every railway has crossings of both extremes of traffic. As these crossings, which number more than a quarter million, involve a total investment of at least $50,000,000, the selection of the most economical type for each installation becomes a matter of no mean importance.

Entirely aside from considerations of economy, railway officers cannot afford, when determining upon their standards for highway construction, to overlook the effect of good crossing construction on public good-will. In these days when practically everyone drives an automobile, a bad jolt or a broken spring incurred in driving over a railway track will neutralize all of the efforts that the most active railway public relations staff can exert. A smooth-riding, well-maintained highway crossing is an effective public relations agency.

In the development of the designs that are now available, manufacturers have rendered a constructive service. In view of the openness of mind which now prevails among railway men, the manufacturers are in a position to contribute still more largely to the solution of this problem by continuing to study most closely the conditions that must be met by the railways, by insuring that their designs meet these conditions most fully and, finally, by acquainting railway officers with their designs and the merits thereof. In so doing, manufacturers can not afford to foster slip-shod methods of construction, for in the development of their standards, railway officers are looking more and more to ultimate annual costs, all factors considered. No better evidence of this fact may be cited than the thousands of installations that have already been made of the most expensive forms of construction. In recognition of this attitude, several manufacturers of less expensive forms of construction are today giving the closest attention to refinements of their designs to prevent early failure and to promote long and satisfactory service. All in all, the highway crossing offers one of the most promising fields today for improvement in construction practices.

SURFACING

Has Track Been Raised Too Often?

IT has been said that adversity is a severe teacher, but that those who would learn, learn well. With the return of better times, it is to be expected that many of the practices in maintenance that have been developed during the last three years will be continued as a matter of routine.

Out of the conditions which have confronted maintenance officers during this period, there has developed a growing belief in some quarters that in the past track has been given a general surface at too frequent intervals. In other words, they have found that they can keep track in smooth-riding condition for a much longer period than they thought, without giving it a general surface. At the same time, where the work has been done properly, the condition of the ballast has not deteriorated appreciably and the drainage has remained satisfactory.

It is obvious that if the ballast is dirty and the ties are churning, the ballast must be cleaned. In many cases, it is also necessary to raise the track. On the other hand, there have been numerous instances during these years where track that was thought to need a general raise, has been maintained in smooth-riding condition by merely giving it the light or spot surfacing of routine maintenance, and this has been done without detriment to the track or ballast.

In speaking of this matter, an experienced maintenance officer said recently that "we have been surprised to

learn that we have been raising our track too frequently and apparently have used far too much ballast. As a result of our recent experience, we believe that we will be able to extend our interval of overhauling our track to a minimum of 10 years and in some cases this can be extended to 15 years." During this conversation a case was cited of a busy section of multiple track in a large terminal, which had been maintained to a high standard for more than 20 years without having had a general raise. In fact, a general raise was impracticable because of the numerous steel bridges which carried the tracks over the city streets.

Growing out of the lean years of this difficult period, it is certain that many of the practices of track maintenance will be altered or superseded altogether. If the experience of this officer, and others, is typical, it is quite likely that in the future closer supervision will be given to the methods of routine surfacing with a view of conserving both the material and labor that are involved in a general overhauling of track. This presupposes, however, that equal attention will be paid to keeping the ballast clean to insure free drainage.

DO YOU SEE?

Every Maintenance Man Must Use His Eyes

NO faculty of the maintenance officer is of greater importance than the power of observation. Some men are naturally keen observers, others acquire it through training, reinforced by a keen interest in their work. But whether this ability is natural or acquired, it is an essential attribute of the man who hopes to be a success in any maintenance of way work.

Obviously, keen observation plays its primary role in the detection of defects; the trained observer sees what is wrong without apparent effort. The objectionable condition, whether it is a broken angle bar, a missing bolt, or an open gate seems to register on his mind automatically. It goes without saying that every first-class track foreman of experience possesses this faculty to a high degree—in most cases without realizing it. However, essential as this attribute is in the foreman, it is of even greater importance for the supervisor. It is not only his means of checking physical conditions, but also the basis for his conclusions as to the performance and effectiveness of his gangs. In other words, he must see enough in a few minutes to give him a good idea of what a gang has been doing during the previous eight hours or more.

Keen and accurate observation does not attain its greatest value unless it is coupled with a retentive memory. In some individuals this power is almost photographic—conditions, scenes or occurrences being so thoroughly recorded that almost no detail is lost. While such phenomenal ability is not necessary, it is essential that the supervisory officer become sufficiently proficient in memorizing the picture of his territory that he can reproduce almost any part of it, either to understand a trouble report or describe almost any location to a superior officer.

Ability to see accurately and remember what is seen is a rare gift as applied to momentary incidents, for example, the circumstances of an accident. Studies of court testimony and tests of college classes, demonstrate that few people have a natural ability to get a vivid, accurate and detailed mental record of what takes place in two or three seconds, and yet such ability in the railway employee, especially the maintenance man, is often of great value to his company in connection with the investigation of the causes of accidents.

The maintenance man has an unusual opportunity to train and test his power of keen observation, the quality of which will determine in no small part his capacity for increased responsibility. In these days of reduced forces, alert and untiring eyes mean more than ever before to the man on the job.

FIRE HAZARDS

Present Conditions Call for Increased Watchfulness

IT has long been an established policy of railway managements to insist on neatness and orderliness of the property. This is owing in part to a desire to create a favorable impression on the public and to improve morale, but it arises in large part also from the knowledge that orderliness facilitates the detection and correction of defects. Broken parts in a motor car covered with grease are not nearly so likely to be detected as in a car that is kept clean. Weed-choked ballast has long been recognized as a deterrent to effective inspection, aside from its other objectionable effects.

However, in these days, railway managements have been compelled to disregard appearances to the end that available funds may be devoted entirely to measures designed to insure safety and efficiency of train movements. Because of this, less time is devoted to cleaning up rubbish, to scalping grass under bridges, and other work of a similar character, thereby producing conditions that promote fire hazards or at least decrease the effectiveness of measures for checking up on the presence of serious fire hazards.

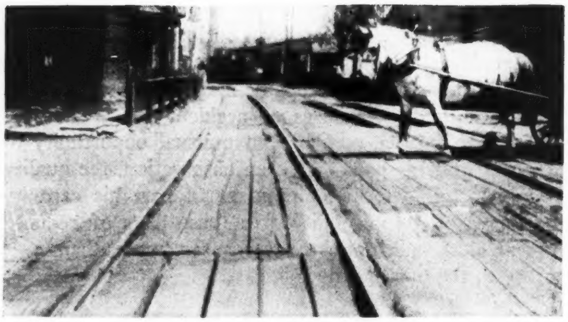
The difference between fire-safe conditions and real fire hazards is often merely the difference between good housekeeping and poor housekeeping. Not only does a failure to clean up often produce conditions favorable to the propagation of a fire, but it may result in the concealing of fire hazards for which the untidy condition may be in no wise responsible.

But the railways are faced with danger of fire from an entirely different source, namely, the buildings which for various reasons are not now being used. Vacant buildings are always an invitation to trespassers, either children in search of adventure, or tramps, but in these days of unemployment the pre-empting of any form of enclosure for temporary shelter is all too common, and such irresponsible occupancy is invariably attended by a high fire rate.

There is no easy answer to the problem of increased fire hazard, other than to suggest that he who fully appreciates the menaces that confront him, and does what he can to combat them, will have less trouble than he who shuts his eyes to the objectionable conditions.

What Kind of a Grade

A resume of the experience of railway engineers with existing designs and of their search for a satisfactory form of construction



The Untreated Wood-Plank Crossing Harks Back to the Horse and Buggy Days

DOES the wood plank crossing meet the demands of modern highway traffic or must it give way to some other form of construction? If the latter, what form shall it take and what materials are best adapted for this purpose? These are only a few of the many questions that have arisen among the railways with respect to the 238,000 grade crossings which they are required to maintain across their tracks, by reason of the revolutionary changes that have been taking place in recent years in both the volume and character of highway traffic.

In the main, railway engineers are agreed that the untreated wood plank crossing has outlived its usefulness for heavily traveled highways, but the changes in highway traffic have occurred so rapidly that there has been little opportunity as yet for crossing design or maintenance practices to keep pace with them. As highway vehicles have increased in speed and weight, numerous forms of construction have been devised to meet the constant demand for better crossings. Yet, to a very large extent, the present standards of crossing construction are not satisfactory, as is clearly indicated by replies that have been received to a questionnaire on this subject from chief engineers and engineers maintenance of way of more than 40 representative roads reaching every section of the country and including more than 150,000 miles of lines. It was equally apparent from the replies that, without exception, these officers are deeply interested in finding a solution of the problems of grade-crossing construction and maintenance, and that they are now giving these matters most serious consideration.

With only a few exceptions, these officers advise that they do not consider their present standards satisfactory, although some of them have been adopted as recently as four or five years ago and others within the last year. Nearly all of those who replied said frankly that they are searching for a form of construction that will meet the requirements of present-day highway traffic; that will have a relatively low cost of maintenance, all factors considered; that will require a minimum of attention; and that will remove or reduce the restrictions to track maintenance, which are imposed by some of the forms of construction now available.

Uncertainty and Confusion Prevail

Some of the crossings that have been tried have failed to stand up under the wear and tear imposed by highway vehicles. Others have resisted this traffic but have gone to pieces by reason of the movement of the rails under cars and locomotives. Still others that have been satisfactory in these respects have not possessed the proper traction, have required excessive maintenance, have interfered too much with track work or have been considered too expensive. To further complicate matters, much rerouting and diversion of highway traffic have occurred as a result of improved highway construction, so that relatively unimportant crossings have suddenly been called on to carry traffic of greater volume, speed and weight. As a result of these changing conditions and the experience thus far in trying to keep abreast of them, there is much uncertainty and confusion among railway officers as to the proper solution of the problems of grade-crossing design and maintenance.

Indicative of this uncertainty, 21 of the officers replying to the questionnaire stated that while the wood plank crossing is still their standard form of construction, this form of crossing is not satisfactory and that they have deviated from the standard to make extensive installations of other types in an effort to find one or more that will meet their needs and at the same time demonstrate ultimate economy. Five roads have standardized on some form of bituminous materials and two have adopted precast concrete plank as standard. Five roads stated that they have no standard but are installing crossings of the types that seem best suited to the conditions surrounding each individual case. Similarly, eight roads reported that owing to the varied requirements in different states they have more than one standard. Some reported from five to nine types in use, not all of which have been standardized, however. Several roads advised that certain forms of construction that are approved by the highway department of one state may not be permitted in another.

Standards Not Being Followed

Still further illustrating this confusion, two roads stated that while they have standards, they are not conforming to them. W. A. Spell, chief engineer of the Atlanta, Birmingham & Coast, expressed the uncertainty with which railway officers view the situation in his statement that "while we have a standard highway plan, I do not believe that there is a single crossing on our road that is built in accordance with it."

It is of special interest to note that while many of the roads have not changed their standards from those of 20 years ago and are still installing crossings in accordance therewith, all but a few are retaining them only because they have not yet found a form of construction which they are willing to adopt as a standard. Furthermore, several of the roads that have adopted later standards indicated that they have done so only tentatively and that they are continuing their search for still more satisfactory forms of construction. Practically all of the roads reported test installations of various types. Thus, A. Anderson, engineer maintenance of way of the Chicago,

Crossing?

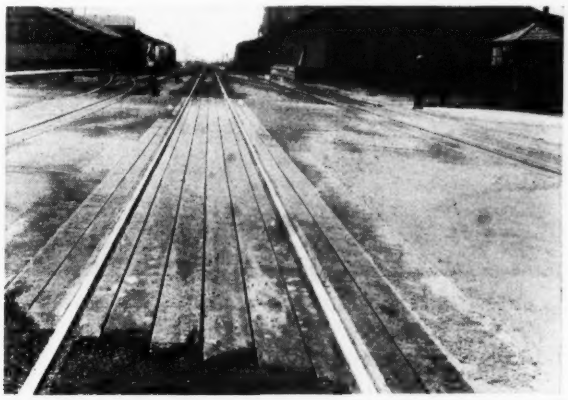
Indianapolis & Louisville, listed 16 different forms of construction that are now under test on that road. In like vein, C. T. Jackson, assistant engineer maintenance of way of the Chicago, Milwaukee, St. Paul & Pacific, reported that this road has about 30 test crossings installed under a wide variety of railway and highway traffic conditions. W. G. Brown, engineer maintenance of way of the Florida East Coast, also reported that "we are experimenting with several types."

Some Consider Wood Plank Best

Most, but not all, agreed that the wood-plank crossing has outlived its usefulness and should be superseded, except possibly at highways of light traffic, by crossings of more modern design. Yet, the wood plank crossing still predominates in all sections of the country and on all but a few roads, and this type of construction is still in service on some of the busiest crossings.

Voicing the view point of those who do not believe that a better crossing has yet been devised, Armstrong Chinn, chief engineer of the Alton, said that "we have found that we can install a smoother, better-riding and quieter crossing with plank than with any other material. In view of its low initial cost, the ease with which it can be installed and renewed, and the facility with which it can be taken up and replaced to permit work on the track, we expect to continue the plank crossing for some time to come." In like manner, P. C. Newbegin, chief engineer of the Bangor & Aroostook, states that "we use plank crossings almost exclusively, for they have given satisfaction and appear to meet all requirements as we have very light traffic on our highways."

There are those, however, who believe that the untreated plank crossing no longer meets modern service and economic requirements and have substituted, therefore, treated timber of certain species, especially gum. Among these is G. W. Harris, chief engineer of the

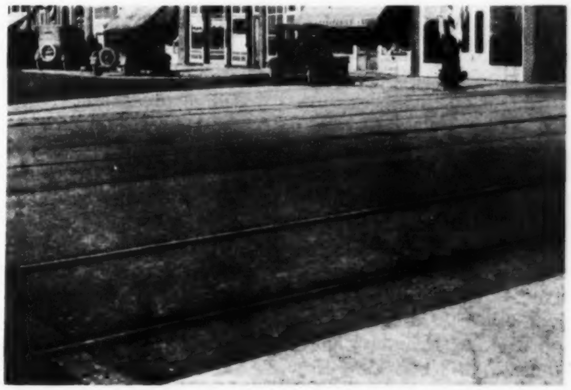


Creosoted Gum Crossing

Atchison, Topeka & Santa Fe, who has standardized on treated timber construction and uses creosoted black gum principally. Mr. Harris stated that "this standard was adopted in 1928 and has rendered very satisfactory service under modern highway conditions. It is an improvement on our previous standard, because we frame the timber before treatment and use black gum, which has excellent wearing qualities. In my view, this is the best form of construction, based on first cost and the fact that it can be placed, repaired and renewed by section forces without special supervision or special tools."

Of the same mind is A. N. Reece, chief engineer of the Kansas City Southern, who advised that "our standard, which has been in effect for about 15 years, is 4 in. creosoted gum crossing plank, fastened with lag screws," and added that "there has been no change or deviation from this standard in recent years except to make some experimental installations of other types. Our experience has not been sufficient to say with any degree of certainty what the ultimate life will be. We have many crossing planks that have been in service for 14 years and are still in reasonably good condition."

Likewise after describing the experience of his road with several types of permanent crossings, C. S. Kirkpatrick, chief engineer of the Gulf Coast Lines, asserted his preference for creosoted gum plank which that road has adopted as its standard, "because they are easily removed when necessary to make repairs. When worn, they can be built up by placing an asphalt wearing surface; or this can be done when they are first laid. On crossings involving multiple tracks, we make the planking continuous and find it easy to take out a few planks when they become worn, thus spreading the cost over a longer period. An attractive feature of this type of crossing is that it costs, including a wearing surface of asphalt, about $3.75 a running foot of track." In a similar vein, J. E. Willoughby, chief engineer of the Atlantic Coast Line, commented that "where the traffic is sufficiently dense to require the highest type of crossing, the most desirable form of construction is creosoted plank."



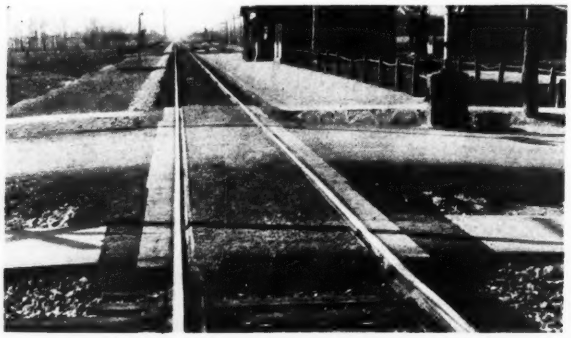
A Four-Track Rock Asphalt Crossing

Rock Asphalt

One of the early substitutes for plank was rock asphalt, of which 18 roads reported installations covering periods of service up to 10 years. A number of these roads called attention, however, to the importance, with this type as with other bituminous materials, of placing the track on a solid foundation at the time of installation and so maintaining it as to reduce to a minimum the movement of the rails under passing wheels and the breaking up of the crossing materials adjacent thereto. Mr. Anderson's description of the methods employed on the Monon when installing all types of bituminous crossings, is typical of those that are followed on other roads. He said that "we have made it a practice on every new crossing first to clean out the old ballast and put in a good base of crushed rock, which is allowed to run awhile

under traffic. We then replace all ties with new creosoted ties, install tie plates and tamp solidly, generally with tie tampers, fill with crushed rock to the top of the rail and allow this, in turn, to run awhile. Later we apply the surfacing material. If the track is not on a solid foundation, there is a tendency toward more or less vertical movement under passing trains, which shakes the surface material loose, causing holes to develop."

Based on the experience of his road, C. S. Robinson, engineer maintenance of way of the Maine Central, reported that "for our first-class crossings we have installed



A Bituminous Crossing with a Flangeway Guard

various types, including rock asphalt and other bituminous materials. The installation costs do not vary widely, rock asphalt showing the lowest labor expense. For ease in repairing damage caused by highway traffic, rock asphalt has many advantages."

"On the Southern Pacific," according to E. A. Craft, engineer maintenance of way of the Texas and Louisiana lines, "installations have been made of various forms of rock asphalt and asphalt macadam. Rock asphalt crossings, if provided with a good solid base, can be expected to last from 10 to 20 years with minor surfacing repairs from time to time. This type must be destroyed, however, when tie-renewal or surfacing is required." According to J. A. Peabody, engineer maintenance of way, the Chicago & North Western has also had rock asphalt crossings in as long as 10 years.

"During the last 12 to 15 years," said C. B. Hoffman, Jr., engineer maintenance of way of the Western Maryland, "we have constructed approximately 200 permanent crossings of various materials. Our present standard is rock asphalt over well-compacted crushed stone. We have made no changes since this standard was adopted three years ago, but we intend to install an additional line of rail on each side of the running rails and 12 in. therefrom to lessen the damage to the crossings from the crowding action of vehicles."

Other Roads Advocate Bituminous Materials

Experience has led other roads to believe that under the present development of grade crossing construction, the bituminous type most nearly meets their needs. This form of construction falls into two classes, the penetration type, in which the base, usually crushed stone or slag, is placed and consolidated, after which the bituminous compound is spread over the surface and allowed to filter through the mass for the two-fold purpose of acting as a binder and providing a wearing surface; and the premixed type in which the aggregate and binder are mixed before application, commonly on the site of the crossing. Both types are used with or without flangeway guards as conditions seem to warrant.

In general, the penetration type of bituminous crossing is the least expensive to install, often costing less than untreated plank, and, in many situations, lasting from 3 to 10 years. According to Mr. Anderson, "the Monon has found that it can be made practically permanent if patched as soon as the need for repairs arises."

Other roads prefer the premixed type. For example, Earl Stimson, chief engineer maintenance, advised that "on the Baltimore & Ohio we have 6,798 highway grade crossings, of which 95 per cent are bituminous concrete, 3 per cent are armored concrete slabs, and the remainder consist of plank or old-rail construction. We have been installing the permanent types over a period of 13 years and have reached the point where we now construct plank or rail crossings only where demanded by local authorities."

Another road that has standardized on bituminous materials, the Delaware, Lackawanna & Western, has many crossings of this type in service, concerning which G. J. Ray, chief engineer, reported that "we have used mastic crossings extensively and find them far superior to plank. They afford the roadbed almost complete protection from rainfall, since little or no water can get through them when properly laid. For this reason, it is less difficult to keep the track in good condition."

Using bituminous materials exclusively, G. A. Phillips, chief engineer of maintenance of the Lehigh Valley, replied that "all of our crossings are of oil and stone construction, although we embed rails in some of those carrying heavy traffic. We believe that this construction is economical from the standpoints of both installation and maintenance, and that in the long run it is the least expensive type."

N. & W. Likes Bituminous Type

The Norfolk & Western, as reported by W. P. Wiltsee, chief engineer, adopted a bituminous type of crossing about 10 years ago because "this type of crossing is easily altered, widened, etc., and the construction varied to meet almost any estimate of cost or density of traffic. In this 10 years, we have installed more than 1,000 crossings of

Preformed Asphalt Plank on a Four-Track Crossing

this type." The Boston & Maine has also installed approximately 300 crossings of this design within the last few years.

Having abandoned wood plank as its standard, the New York, New Haven & Hartford, according to E. E. Oviatt, chief engineer, "began about 1920 to install bituminous materials, since which, up to January 1, 1933, we have replaced 995 plank crossings under a wide variety of highway and rail traffic. Our experience has proved this to be a desirable form of construction, but the results depend on the care taken in making the installation and whether it is properly maintained thereafter."

On the Peoria & Pekin Union, "a cinder-asphalt mixture has been used with marked success," according to E. H. Thornberry, chief engineer, "and is holding up remarkably well." Another who commented on the use of bituminous construction was E. M. Hastings, chief engineer of the Richmond, Fredericksburg & Potomac, who believes that "bituminous materials, if well put down, give the most desirable crossing from the standpoint of highway traffic, but are difficult to maintain next to the rail."

When installing either rock asphalt or other bituminous crossings, some roads compact these materials snugly against the running rails, while others lay planks next to the rail to provide a flangeway, as in a plank crossing. Many of the roads are turning more largely, however, to specially designed metal flangeway guards and find this the most effective means of prolonging the life and smooth-riding qualities of these types of crossings, individual roads having more than 75,000 lin. ft. of such construction in service. Flangeway guards for this purpose are of both open and closed-trough designs, the former permitting stones and other small objects in the flangeways to fall through, while the latter are intended to protect the ballast and subgrade from rainfall. In some instances a similar device is used also outside of the running rails, thereby protecting the wearing surface both inside and outside from damage occasioned by the vertical movement of the rails. Typical of practices with reference to this detail of crossing design, W. P. Wiltsee, chief engineer of the Norfolk & Western, advised that "we install flangeway guards next to the running rails for the heaviest traffic, but do not use them for crossings of light traffic."

Preformed Asphalt Plank

Somewhat akin to the bituminous crossings are those of preformed asphalt plank, of which 12 roads reported installations. Unfortunately, some of the earlier installations of this type failed to meet expectations, the material being so plastic that it flowed under traffic. Later changes in the method of manufacture have improved the product, however, and A. F. Blaess, chief engineer of the Illinois Central, reported crossings of this type that have been in service six years, which compare favorably with other types on this road. In commenting on the probable life of the different types now in use on that road, including asphalt plank, Mr. Blaess said, "with respect to service life, the performance of the different types of crossings mentioned has generally been quite satisfactory, although the length of time since they were installed is not such that I would care to predict an ultimate service life for any of them."

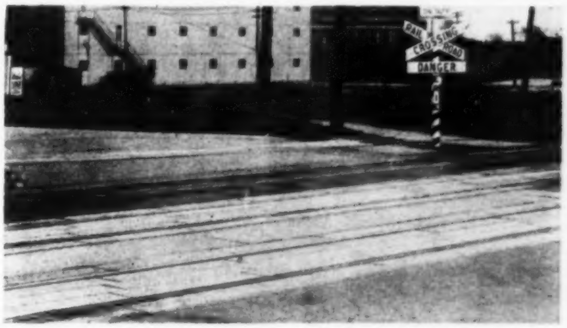
Another road reported that preformed asphalt plank give excellent service on crossings that can be left undisturbed for a long period, but did not recommend them for crossings where they must be taken up in whole or in part at frequent intervals. In this connection, several roads reported installations of this material for the wearing surface of overhead highway bridges, saying that it had been very satisfactory in this application, while others have used large amounts as protection for waterproofing.

Armored Crossings Are Popular

As is to be expected where so much uncertainty has existed and such active efforts have been made to find a satisfactory form of crossing construction, many roads have endeavored to develop designs of their own. In doing this, a large number have installed what has come to be known as the armored type. This consists of a series of second-hand or scrap rails set workway parallel to the running rails to fill the space between them, and in some cases extending also to the ends of the ties, while in others, wood plank or other materials are placed outside of the running rails. The spaces between the rails are filled with such loose materials as cinders, broken stone or gravel, with concrete or with some bituminous compound.

Nineteen roads reported installations of this type, some of them indicating that it is satisfactory and that a large number of these crossings are in use, while others have found it unsatisfactory and have discontinued its use. Peculiarly enough, however, some of the roads that have been most active in their efforts to find a solution of the grade crossing problem made no mention of having used this type.

Speaking for the Alton, Mr. Chinn said that "for a while we installed rail-type crossings. They were satisfactory for crossings of approximately 90 deg., but did not prove to be very good for more acute angles, since there was a tendency for wheels to catch in the spaces between the rail heads and skid. Neither were they satisfactory from the standpoint of maintenance, since too much labor was required to take them up for tie renewals, rail replacement, surfacing and lining."



Precast Concrete Plank

"On the Central of Georgia," said C. E. Weaver, assistant general manager and chief engineer, "we have adopted no specific type of crossing construction as standard, since the requirements of different localities and conditions do not permit. In recent years, however, we have confined ourselves rather generally to the use of the scrap-rail type of crossing, which has been satisfactory in every instance. During the last 5½ years, 43 crossings of this type, embracing 98 tracks, have been installed."

Other Comments

H. R. Clarke, engineer maintenance of way of the Chicago, Burlington & Quincy, advised that "this type is considered the most economical and is largely used." Likewise, the Rock Island has had a favorable experience with this type, for as explained by W. H. Peterson, chief engineer, "where the track has been well surfaced and the drainage placed in good condition prior to installation, this crossing requires little maintenance for several years." On the other hand, Mr. Kirkpatrick reports that it has been the experience of the Gulf Coast Lines that "the T-rail crossing is very good where the rail traffic is light and the vehicular traffic is heavy, but that where both are heavy these crossings heave and are not satisfactory." According to Robert Faries, assistant chief engineer-maintenance, this type has not been satisfactory on the Pennsylvania, since "this construction is quite expensive, becomes rough when the bituminous material wears down,

and cannot be removed readily to permit track work." "On the St. Louis-San Francisco," said Col. F. G. Jonah, chief engineer of this road, "the old-rail type is generally installed at heavy-traffic streets and highways, regardless of traffic on the railway. This is practically everlasting, so far as the rail wearing out is concerned, but it must be taken up from time to time to permit resurfacing the track." Among other users of this form of construction, the Baltimore & Ohio has 200 crossings in service.

Precast Concrete Slabs Find Favor

While precast concrete slabs are reported to be standard on only two of the roads under discussion, they are used extensively on a few others and to a limited extent on some of the remainder. The extent to which this form of construction is used is indicated by the fact that more than 1,000 crossings have been installed of slabs from

Precast Slabs Enclosed in Steel Channels

the plants of a single manufacturer. The oldest crossing of this type was reported by R. P. Forsberg, chief engineer of the Pittsburgh & Lake Erie, who said that "a concrete plank crossing was placed over a switching track in 1914 and is used by passenger automobiles and pedestrians. Several of the slabs were broken by a derailed car in 1919, but the crossing is still in place and after 19 years' service is in fair condition."

Erie Gives Up Wood Plank

Typical of a number of roads that have changed their standards in an effort to keep pace with highway traffic, the Erie, according to J. C. Patterson, chief engineer maintenance of way, "had given up the use of wood plank and for a number of years prior to 1928 had used a bituminous concrete on heavy-duty crossings and rock asphalt on the remainder, except in cities where regular asphalt construction was used to conform to the local paving. In that year, we began to use precast concrete slabs and up to the present, we have installed 185 of this type, besides 8 cast-iron and 1 steel crossing. We are still using the bituminous concrete for all but heavy-duty crossings."

"Concrete slab crossings provide a smooth-riding surface for highway traffic, while they permit better and more economical track maintenance than any other type we use. We have installed 75 of these crossings since 1927 and consider them permanent as Class I construction," said A. C. Harvey, chief engineer of the New York, Chicago & St. Louis, who added, "it has been our observation that both the public and public officers prefer this type to our other forms of construction, and our experience leads us to believe that the concrete-slab crossing is preferable in the majority of cases."

"Owing to our belief that the rapid development of highway traffic has introduced problems as yet unsolved," said Mr. Peterson of the Rock Island, "we have not yet developed a standard for so-called permanent highway crossings. While we still use wood plank, principally because of its cheapness and serviceability where highway traffic is light, we have installed many other types, among them the concrete slab. A number of this type, made up of sectional units, have been placed under heavy highway traffic, some having seen service up to four years. They are giving good service and have not as yet required any maintenance. This type can be made practically water tight. If properly installed, it has the added advantages of providing a smooth surface and can be easily removed to permit track maintenance or the relaying of the rail. As against this, this type requires the renewal of the ties and ballast, and thorough tamping, as well as particular attention to drainage when the installation is made, to avoid any undue increases in track maintenance."

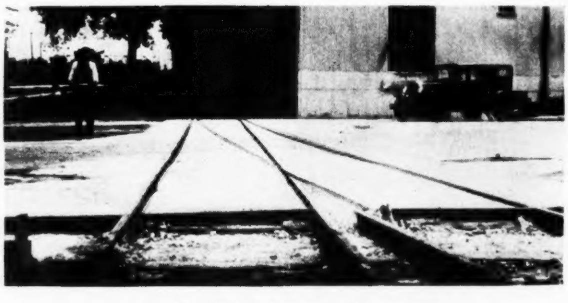
That details of construction may make considerable difference in the results obtained from this type, as well as others, is indicated by W. J. Backes, chief engineer of the Boston & Maine, who said that "we have two test crossings of concrete plank; in the first, the slabs were made with square edges and angle-iron protection at the corners, which has not worked out to good advantage. The second crossing, which has been in service about two years, was installed with concrete plank having rounded edges and no angle irons. So far this crossing has been very satisfactory."

Monolithic Concrete Construction

In their search for a satisfactory form of crossing construction a number of roads have visualized the possibilities of monolithic concrete construction. C. E. Weaver, of the Central of Georgia, stated that his road has constructed crossings of this type, as well as with a brick surface on a concrete base, but gave no data as to the service they have rendered.

"In many cases," said H. R. Clarke of the Burlington, "where a highway crosses a yard or sidings, the tracks are first placed in first-class condition as to ties, etc., and are then concreted in across the highway. This construction is also followed sometimes on very light branch lines. These crossings have already given several years service and present reports indicate that all of them are still in an entirely satisfactory condition."

A somewhat more elaborate form of construction, in which the concrete extends to a depth of two feet or more below the top of the rail, was reported by P. D. Fitzpat-



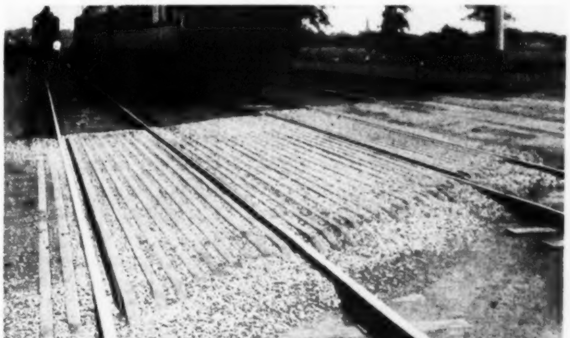
A Monolithic Concrete Crossing

rick, chief engineer of the Grand Trunk Western, who reported that, in conjunction with the installation of concrete slab construction in main lines "on sidings and certain of our light-traffic lines where the highway traffic is heavy, we have resorted to a monolithic concrete-encasement type of crossing which has proved to be quite satisfactory. An obvious disadvantage of this construction is that the track rails are embedded, which increases the amount of maintenance adjoining the crossing to prevent damage to the rail."

Still another type of crossing construction that is receiving increasing attention, not only with respect to the number of roads on which they have been applied, but also as to the number of installations, is the metal crossing of either steel or cast-iron sections. Twenty-one of the roads replying to the questionnaire reported installations ranging from one or two to as many as 50, involving up to 13 tracks for a single installation. Incomplete records show more than 500 installations of this form of construction, aggregating more than 20,000 lin. ft. of track, or nearly 4 miles. Commenting on the experience of the Chicago & Illinois Midland, which operates through a section of the country that has recently seen a large amount of highway construction, C. H. Paris, chief engineer, said that "during the last six years we have installed 50 so-called permanent highway crossings of both metal-plate type and rail construction, usually in connection with the construction of hard surfaced roads or of paved streets. Our oldest installation has now been in for six years and is in excellent condition. The only maintenance so far required has been the renewal of the untreated timber shims. We now use only treated shims."

With respect to this type, Mr. Peterson said that "we have installed a number of all-steel crossings of various designs and find that they stand up well under traffic. They have the disadvantage, however, of not being water tight and many of them are subject to corrosion from brine drippings. Most of them come in sections and have the advantage, as compared with the armored (rail) type, of not requiring complete removal to permit tie renewals and surfacing. On the other hand, the better designs are more expensive because they are heavily reinforced to prevent breakage."

"In the period between 1924 and 1931, both inclusive, the Southern Pacific installed 4,267 lin. ft. of cast iron crossings," said Mr. Craft. "They have been employed only at intersections with heavily traveled city streets or important highways. They have now been in service up to nine years and there is no indication as to how long



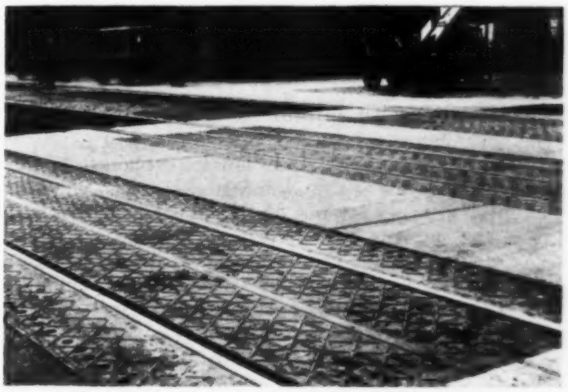
An Armored or Rail Crossing

they will last, as all are in good condition, but we believe that a service life of 40 years is a reasonable estimate. Obviously, however, repairs will be necessary from time to time with respect to the wooden wedges, screw spikes and other accessories. This type costs more than others in the first instance, but compares favorably in this respect when reduced to an annual cost basis, particularly under conditions imposed by heavy street and rail traffic."

Reviewing his experience with this type of crossing, Mr. Clarke said that "on heavy traveled highways, particularly on hard-surfaced streets and roads, the Burlington uses three types of metal crossings, the armored or rail type, and rolled steel plates or cast steel, the latter two being employed where train speeds are such that the armored type is not considered desirable because of the difficulty of leveling and smoothing the track through the crossing."

Costs of Installation and Maintenance

While the general relation between the costs of installation for the various types of crossings that have been mentioned seem to be fairly well maintained as between roads and for the group as a whole, the costs for any type vary over a relatively wide range when compared individually. This can be explained in part by differences in the local costs of the constituent materials or in the prices quoted by different manufacturers



One Design of a Cast Iron Crossing

for their products; and by variations in the design for the same type, which often cover a wide range. These factors do not, however, fully account for all of the differences that were shown, since different roads reported rather wide variations for substantially identical forms of construction, indicating differences in the methods of computing the completed costs, some roads apparently including the cost of conditioning the track preparatory to making the installation, while others did not.

Based on the figures given, a completed crossing of untreated wood plank varies from $1.50 to $3.75 per lineal foot of track, but with the greater number between $1.75 and $2.50. Similarly, costs for treated plank vary from $2.06 to $5.56. With both materials, however, much of the difference in cost is explained by the woods used, including yellow pine, black gum, Douglas fir, Port Oxford cedar, red oak and white oak, the distance from the source of supply and, for treated material, the character of the treatment.

Cost of Rock Asphalt

Rock asphalt was reported to cost from $0.77 to $4.50 a track foot, but here again the design of the crossing and the methods of installation are important factors in determining the cost. The same is true of other bituminous materials, including both the premixed and penetration types. This range extended from $0.61 a running foot of track to $6, the cost in some cases including the flangeway guard, in others excluding it. Premolded asphalt plank showed the narrowest range of any of the materials for which figures were given, being from $9.47 to $11 a foot. This may be due in part, however, to the fact that fewer roads gave cost figures for this material.

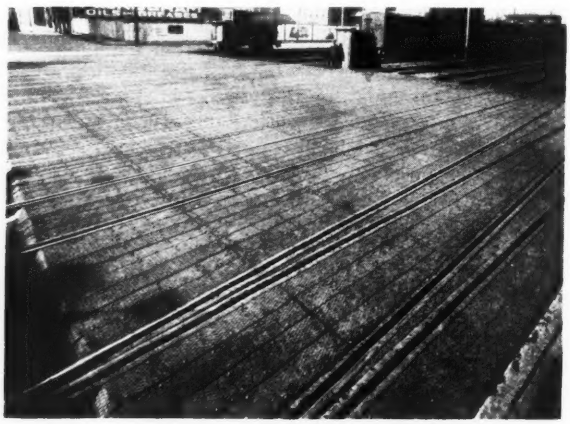
Rail, or armored, crossings showed nearly as wide a variation as other types, ranging from $4.04 to $11.74 a foot, this variation being nearly as great on individual roads as for the group as a whole. The factors which affect the cost of this type are the weight of the running rails, the care with which the installation is made, the amount and importance of the traffic over the crossing during installation, the character of the filling that is placed between the rails and whether the charges for the rails are based on second-hand or scrap prices, or whether, as is done in some cases, no charges are assessed, the rail being carried in a suspense account.

Precast concrete slabs and monolithic concrete construction showed similar variations, ranging between $6.50 a foot of crossing and $11.25 for the former and from $3.92 to $10.25 for the latter. Here again the design must be taken into account, as well as the charges for preliminary track work, in attempting to analyze the costs of these crossings. .

Most Expensive Type

According to the information furnished, the metal type, including cast iron and steel, is the most expensive with respect to original cost, but as explained by Mr. Craft, most or all of this differential is wiped out when the different types are put on an annual cost basis. As given, the cost for metal crossings ranges from $12 to $17 a foot of track. This is another example of the fact that differences in design and of methods of computing the completed cost are, in themselves, responsible for much of the variation that is shown.

No road gave definite figures as to the cost of maintenance of its crossings. There was general agreement, however, that maintenance is lowest for the metal and concrete slab types and that practically no maintenance is required on monolithic concrete crossings, but slightly



A Rolled-Steel Crossing over 12 Tracks

more attention must be given to the track adjacent to the latter. While current maintenance is about the same for the armored type as for metal and concrete slabs, this type has the disadvantage that considerable expense is involved in removing and replacing it when track work of any kind is required.

A number of roads said that only a negligible amount of maintenance is required on rock asphalt and other bituminous crossings, provided small defects are repaired as soon as they become apparent. Others reported that the maintenance on these types is relatively high. The use of flangeway guards, the solidity of the track, particularly with respect to vertical movement, and the severity of winter temperatures are, of course, important factors in determining the cost of maintaining these types.

The replies indicated substantial agreement in the conclusion that untreated plank crossings require the largest amount of maintenance and that this cost is greatly out of proportion to the original cost of installation, often making this type the most expensive when put on an annual-cost basis. On the other hand, the situation is reversed where creosoted timber having high resistance to wear is in use. While, in general, these crossings require more maintenance than some of the more per-

A Second Design of a Cast Iron Crossing

manent types, this cost is still relatively low, and on the annual cost basis compares favorably with other types. Confirming this conclusion, A. Montzheimer, chief engineer of the Elgin, Joliet & Eastern, reported that "creosoted plank crossing is very satisfactory with respect to the cost of both installation and maintenance."

Considerations Affecting Selection of Type

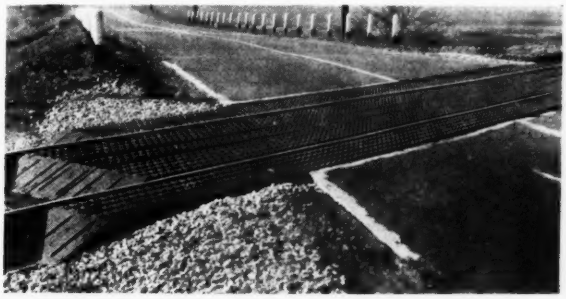
Two questions were asked in the questionnaire as to the considerations that influence the selection of the type of construction to be used at any crossing. With few exceptions the answers were that the density and character of the highway traffic are the most important considerations, particularly as they affect the permanence of the crossing. Coupled with this, however, is the smoothness of the surface. In other words, it would not be considered expedient to install a crossing at an important highway, regardless of cost, which would last only a year or two, or one on which a smooth-riding surface could not be maintained.

Next in the order given was ease of maintenance, referring both to the crossing itself and to the facility with which the track can be kept in surface and line. It was mentioned repeatedly that the design should be such that these operations can be accomplished without impeding either highway or rail traffic.

As collateral reasons, the type of pavement adjacent to the crossing, the specific requirements of municipalities, sometimes by ordinance, and the preference of highway officers were given as having a direct influence on the selection. Some roads also differentiate between streets and highways upon which high-speed passenger vehicles predominate and those carrying heavy trucking traffic. Several roads mentioned the fact that the angle of the crossing is the deciding factor, since some types are not suitable for acute-angle crossings. Again, some types of construction give excellent results where the rail traffic is comparatively light, but fail when applied to crossings which must carry a heavy-tonnage or high-speed rail traffic, or on crossings which must be surfaced and lined frequently. One road called attention to the

fact that no satisfactory design, other than plank, has yet been worked out for those situations where the roadway crosses a turnout.

It should not be assumed from the foregoing that either original cost or ultimate economy is ignored in making these decisions, since there was scarcely a reply that did not stress these considerations. It is evident from the discussions that railway officers are as deeply interested in matters of cost and economy as in any other feature of the crossing problem, and most of them said so explicitly. They recognize, however, that the better and more permanent types of construction will, in general, be more expensive in first cost than those of lower quality and of shorter life, and that low first cost does not necessarily imply ultimate economy. As an illustration of this thought, J. R. W. Davis, chief engineer of the Great Northern, said that "the greater the density of highway traffic, the larger the investment in crossing construction that is justified."



A Pressed-Steel Crossing

Safety was frequently mentioned also as one of the factors which must be given consideration. While most of the construction in common use is considered satisfactory in this respect, several instances were cited in which serious hazards were involved. This seems to be particularly true of wood crossing plank, as was illustrated by the comment of R. G. Kenley, chief engineer of the Minneapolis & St. Louis, who said that "crossing planks spiked to the ties do not make the safest crossing. We have had loose planks cause havoc with passing trains. We have also paid claims for damaged automobile tires by reason of spikes and loose planks." Improper flangeway design was mentioned as a potential source of danger with some types, and the raising of parts of the crossing by reason of snow crowding underneath from the flangeways was also given as a source of serious danger.

Attitude of Public and Public Officers

Since highway grade crossings are constructed and maintained solely for the convenience of the public, the attitude of public officers and of those who use the crossings becomes a matter of consequence in the consideration of the problem. For this reason, those railway officers to whom the questionnaire was sent were asked to discuss this attitude with respect to the different types in use and as compared with previous types. Some roads replied that the public is little concerned as to the type so long as smooth-riding crossings are maintained. H. S. Clarke, engineer maintenance of way of the Delaware & Hudson, among others, reported that he had been commended by public officers and automobile associations as a result of using certain types. Several roads reported requests from public officers for the installation of certain types that they had seen elsewhere. Mr. Robinson said that in the territory served by the Maine Central, "the public is following with interest the efforts to improve grade crossing construction and increasing criticism is received if the railway's accomplishment fails to keep pace with improved highway construction or attain the high standard demanded."

Mr. Patterson said that it had been the experience of the Erie that "where one modern crossing is constructed in a town, there is immediate agitation for similar treatment at every other crossing in the municipality." E. L. Crugar, chief engineer of the Wabash, said that "there is a growing inclination on the part of city, county and state officers to pay the entire cost of the material required to install certain types of crossings, usually concrete plank or monolithic concrete. In some sections, public officers will also maintain certain types gratis or for a nominal charge." It is the experience of Lem Adams, chief engineer of the Union Pacific, that "the planked crossing is a source of constant complaint from the public, but with the installation of permanent crossings such complaints automatically cease. Such installations undoubtedly do much to improve public opinion."

One of the most interesting comments on this phase of the subject came from Bernard Blum, chief engineer of the Northern Pacific, that "one of the strong arguments we have had for the installation of permanent crossings has been the attitude of the public with respect to them as compared with grade eliminations. In several instances where there has been agitation for a separation of grades, the installation of a concrete wearing surface has caused this agitation to cease."

What the Railways Have Learned

What have the railways learned from the intensive study they have given to the crossing problem? Have any conclusions emerged from the performance of the various types they have installed? In general, the replies indicated that railway officers are still open-minded as to the final solution of the problem. Although they indicated a trend toward certain conclusions, even though these opinions were by no means unanimous. The first was that crossing construction should be graded to conform to the density and character of the travel on the highway; in other words, the best form of construction available should be used at the busiest crossings, that less expensive design can be applied to secondary crossings, while the least expensive should be used at those of least importance. The second is that the construction which is most likely to survive will be that which shows the greatest ultimate economy and which will permit track to be maintained with the least difficulty.

This Miniature Engine, Powered With Two Gasoline Engines, and 14 Coaches Were Presented to the City of Detroit by the Detroit News, and Are Installed at the Detroit Zoological Park

Practicing Safety on the M. & St. L.

By A. H. REETZ

Supervisor of Track, Minneapolis & St. Louis, Hampton, Iowa

AFTER years of earnest endeavor in impressing the safety habit on his subordinates, it is gratifying for a supervisory officer to receive safety reports indicating an almost total absence of accidents among his men. Such is the situation on the Minneapolis & St. Louis with respect to the track department, where the monthly reports on safety matters indicate that the safety record of the trackmen is almost perfect. In view of the success attained by our track forces in reducing accidents, other maintenance men no doubt will be interested in the methods that we have followed in bringing about this reduction in accidents.

Each Accident Studied Carefully

The progress that has been made in promoting safety can be attributed largely to the policy of making a careful study of the facts surrounding each accident, and then taking every precaution to prevent the recurrence of a similar accident. Through this procedure unsafe practices and methods of doing work have been eliminated, one by one, and the track crews are forbidden to use any but safe methods in performing their work. An account of specific cases where accidents were caused by faulty practices, together with an explanation of the methods of doing the work that were adopted to eliminate further accidents, is given below.

In one case a track crew was cutting a rail by marking it with a track chisel and then raising it shoulder high in order to drop it on a short piece of rail on the ground. Owing to the presence of ice on the ground one of the trackmen slipped and fell under the rail, receiving a broken leg. Thereafter, this method of cutting rail was forbidden and instructions were issued to use leverage in breaking rails.

Following another accident in which a laborer received a broken leg as the result of being struck by a tie while unloading and stacking ties, a rule was issued requiring that when doing this work all men in the crew should engage simultaneously in either throwing out the ties or in stacking them. Such a rule is particularly desirable when the ties are treated and of heavy wood.

Proper Use of Claw Bar

Through improper handling of the claw bar when pulling spikes, resulting in fingers being caught between the bar and the rail if the former slipped, many trackmen have suffered more or less severe injuries to their fingers. To eliminate this type of injury, trackmen have been instructed to place their hands on top of the claw bar in such a way as to avoid injury if the bar should give way suddenly. The situation is somewhat similar regarding the use of track wrenches, as injuries to fingers and hands caused by the wrench slipping suddenly off the nut were relatively common. When tightening track bolts, trackmen are now required to stand with their feet wide apart and to apply the pressure with a lifting motion, rather than to lean backwards to pull on the wrench or to push forward or downward.

It is a good practice to remove from service men who seem to have a faculty for getting hurt quite often, even though the injuries received may not be serious. It is even more desirable to take such men out of service before they are injured, if by observation the foreman or supervisory officer can determine that they are inherently careless or otherwise unfitted for the work. Certain types of individuals, especially those who are naturally awkward and clumsy, should never be permitted to engage in railway work.

Much of the responsibility for any success that may be attained in a program for reducing accidents among track forces rests with the track foreman. First of all, it is his obvious duty to observe all the principles of safety, as example is a great teacher and influence among workmen. Furthermore, he should take a personal interest in the habits of each man in his crew, even to the extent of ascertaining whether they are allowing themselves sufficient sleep, particularly if they appear to be tired and drowsy in the morning. With only a few hours rest, few men are in good condition for the day's work and are apt to mar the safety record before the day is over.

When a new man is added to the crew, it is important that not only the foreman but every man in the gang make it a point to observe his actions and give him the benefit of their experience. If he does not respond properly to suggestions and take the matter of safety seriously, he should be removed from the crew.

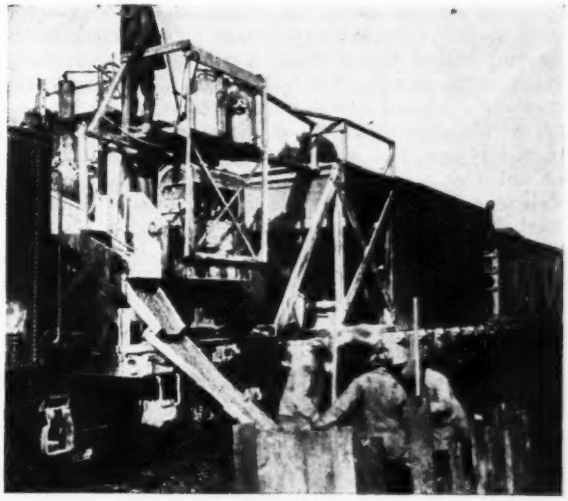
Unusual Accidents

When an accident of a strange or unusual nature occurs, every crew on the division should be informed of the details in order that they may guard against similar accidents. I have in mind such an accident which will serve as an example. A yard foreman discovered a derail frozen tightly in the ice and dispatched one of his men to remove the ice. This man was wearing a pair of muslin mittens which were covered on the outside with a heavy soft fleece. The water around the derail was only partly frozen and as he broke the ice with his pick his mittens became somewhat wet, causing them to freeze to the derail when he took hold of it to throw it over. Being unable to remove his hands from the mittens quickly, he was injured when his fingers were caught between the falling derail and the rail.

A Ford V-8 Sedan Equipped With Firestone Pneumatic Rail Tires, Which Was Recently Placed in Inspection Service by the Great Northern. The Car Is Shown Being Removed From the Track by Means of a Hydraulic Turntable

Concreting Trains Fill Need on the Pennsylvania

Five self-contained, mobile mixing plants pour thousands of catenary bridge footings along the right-of-way in electrification project



Pouring a Footing Direct From the Mixer Car of the Concrete Train

CONFRONTED with the problem of constructing thousands of catenary bridge footings and guy anchors along the right-of-way in connection with the electrification of its line between New York and Washington, D. C., already completed as far south as Wilmington, Del., the Pennsylvania developed and built two concrete trains equipped for the complete mechanical handling and mixing of materials, and found them to be so much more effective than machine mixing on the ground at each bridge site that it immediately built three more similar trains. Carrying sufficient materials for a normal day's work, these trains were moved over the road from bridge site to bridge site, pouring concrete directly into the forms, and were interrupted in their work only when it was necessary to clear for trains. Where track facilities permitted, the trains were also used to prepare the concrete used in the foundations constructed at substations, and on several occasions they have been called upon to mix a limited amount of concrete in connection with maintenance of way repair projects.

The concrete trains consist essentially of two or three bin cars for carrying the concrete aggregates; a mixer car, where the concrete is prepared; an engine tender tank with the water supply; and a cement car, which carries the supply of cement in bulk. These cars are coupled together in the order named, with the bin cars at the rear of the train, and are pulled over the road as a work train.

Special Cars Carry Aggregates

The bin cars are flat cars on which have been mounted two multiple-hopper-bottom storage bins of heavy timber construction lined with sheet metal. The combined bins have a capacity sufficient to mix about 35 cu. yd. of concrete. The bins, one of which is about twice the size of the other and used for the stone, are set well above the platform of the car and are provided with clam-shell-type duplex gates along the bottom, there being nine such gates on each car, six from the stone bin and three from the sand bin. These gates, which serve 10-in. by 12-in. openings, are operated by offset hand levers on each side of the car, so that the operator can always work on the side away from traffic.

The gates discharge directly on a 16-in., power-operated continuous belt conveyor, which extends lengthwise of the car. At the forward end of the car, the conveyor is inclined upward and extended slightly so that it can discharge the stone and sand directly into a receiving hopper at the rear end of the conveyor of the adjacent bin car, or, in the case of the lead bin car, into a receiving hopper serving a conveyor on the mixing car. Each bin-car conveyor is driven by a 10-hp., air-cooled gasoline engine, with a friction clutch. Drive and speed reduction are effected in each case through a steel roller chain and sprockets.

Provision for Winter Work

To permit winter work without the possibility of the freezing or sticking of the hopper-gate and conveyor mechanisms, both sides of the hopper cars were provided with wood door enclosures, and steam heating pipes were placed along both sides of the conveyor beds. In severe weather also, the aggregates were heated in the storage bins at the loading points, and tarpaulins were tied over the tops of the bin cars while on the road.

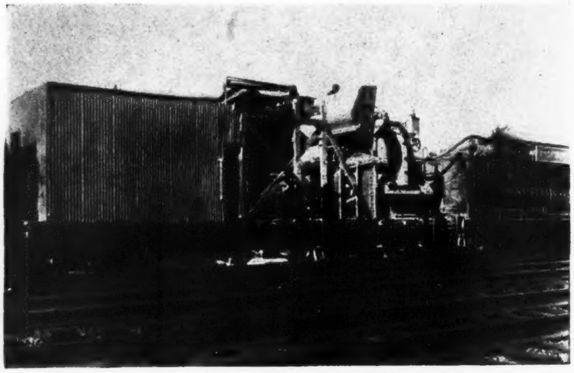
The mixing car, which is also a flat car, is equipped with a $\frac{3}{4}$-yd. concrete mixer, powered with a 32-hp., water-cooled gasoline engine; suitable batching equipment for the strict control of the mix; and an elevating-type belt conveyor, 16 in. wide and driven by a 10-hp. air-cooled engine, which raises the aggregates to a level above the mixer and deposits them into a two-compartment hopper located directly above the skip of the concrete mixer. The mixer is mounted at the forward end of the car, with the axis of the drum set parallel to the center line of the car, in which position the concrete can be discharged forward of the car and into a two-way steel hopper, from which it can be run off on either side. From the hopper, the concrete is conveyed to the forms through standard steel chutes.

All of the material for the concrete was batched to secure positive control of the mix. The two-compartment aggregate bin, which is equipped with hand-operated bottom-dump gates, discharges the sand and stone into the loading skip of the mixer, which has two compartments, marked for aggregate measurement. The cement is dropped from an enclosed bin adjacent to the two-compartment aggregate bin, into a hopper equipped with scales, from which it is emptied into the loading

skip. Water for the mix is supplied from a measuring tank above the mixer, which is refilled from the engine-tank supply by means of a small centrifugal pump, direct-connected to the engine of the mixer. During cold weather, a steam hose is inserted in the water tank, and a heating torch is mounted over and made to discharge directly into the mixer drum.

Bulk Cement Used

In the earliest use of the trains, bagged cement was used, and, to provide a dry storage area near the mixer, the rear half of the mixer car was housed in with corrugated metal siding. Later, however, bulk cement was employed, carried along in a standard steel box car placed immediately ahead of the water tank. This cement was picked up in the car by a portable cement pump or unloader, which forced the cement through a three-inch pipe, extending over the top of the water tank, directly to the enclosed cement bin adjacent to the two-compartment aggregate bin.



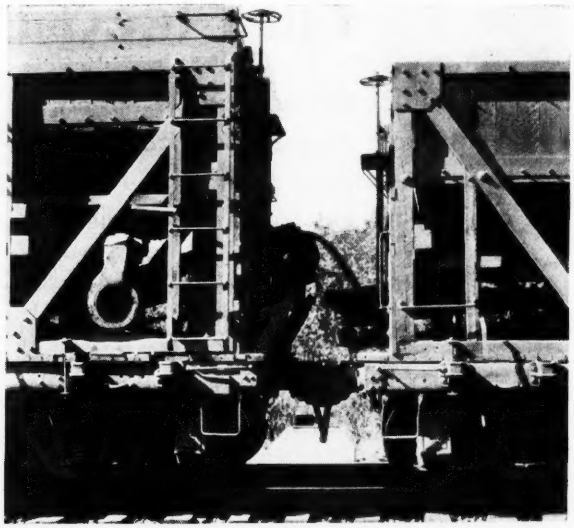
The Track Side of the Mixer Car—Note Bulk Cement Delivery Line Extending Back Over the Auxiliary Tender Tank

The cement pump, which is a relatively small machine, designed to be pushed about in the car by hand, has a revolving blade or cutter, which fluffs up the cement before an inlet, where compressed air blows it a short distance into a screw chamber. From this chamber the cement is forced by a motor-driven screw through the supply pipe to the cement bin on the mixer car.

Twelve-Man Crew Employed

With a crew of approximately 12 men, including a foreman, and material storage sufficient to make up to 105 cu. yd. of concrete, each concrete train was moved over the road, pouring pole footings and guy anchors successively as reached. The crew consisted usually of a mixer operator, a man on top of the mixer regulating the batching of materials, a man on the mixer car platform controlling the movements of the mixer skip, a man in the cement car operating the cement pump, a man on the ground operating the bin gates, a man in the bin cars to insure movement of the stone and sand to the conveyors, four men on the ground to handle the placing of the concrete, and a foreman and a mechanic. With this crew, approximately 15 cu. yd. of concrete could be mixed and placed in each hour of steady pouring, the amount placed each day depending almost entirely upon the effective working hours of the train, unaffected by revenue train movements.

A 25-Kv.a electric generating plant is mounted in the coal section of the water tender in each train, and cable was hung to carry the current to all cars. Energy for the operation of the cement pump and for lighting for night operation is taken from this unit. The main lights provided include a floodlight mounted above the mixer, which illuminated the concrete chutes and the forms, a flood-light at each end of each bin car, arranged to throw



Between Hopper Cars, Showing Engine Drive of the Rear Conveyor and the Receiving Hopper of the Forward Conveyor

light along the conveyors and bin gates, and ordinary socket lights about the mixer car and in the cement car. In addition, outlets were provided at intervals along both sides of the bin cars for plugging in trouble lights.

Bin Cars Loaded Mechanically

Loading of the aggregate cars of the trains has been done by means of special loading facilities installed at suitable points along the line. At all of these points a track hopper and power-operated elevating equipment were provided, so that the aggregates, delivered in hopper-bottom cars, could be handled mechanically. At certain points the loading was done directly from the elevating conveyors, while at several other points, large capacity elevated storage bins were provided, with chutes discharging directly into the bin cars. The latter arrangement, which permitted elevating all of the material while the trains were at work on the road, proved by far the more satisfactory. With this arrangement, the three bin cars of a train could be filled in from 15 to 20 min., whereas, where no storage bins were provided, loading of the same cars required from 3 to 4 hours.

The concrete trains were designed and equipped by the railroad and were operated by the electrification contractor under the immediate supervision of an inspector in the employ of the railroad.

Tie Stocks—There were 32.5 per cent less crossties in the hands of the commercial tie producers on January 1, 1932, according to statistics compiled by the Railway Tie Association from the inventories of producers, whose stocks are estimated to include more than 75 per cent of the total in the hands of all commercial producers in the country. In other words, these producers had on hand, uninvoiced at the beginning of this year, 5,745,599 ties as compared with 8,636,999 ties a year previous. On this basis, there were not more than 7,500,000 ties uninvoiced in the hands of all of the producers of the country on January 1.

Centrifugal Pumps Raise Water 3,153 Ft. in One Lift

Atchison, Topeka & Santa Fe constructs 12,000 ft. pipe line up precipitous cliffs to supply water for its facilities at Grand Canyon, Ariz.

BY INSTALLING centrifugal pumps designed to operate against a pressure of 1,470 lb. per sq. in. and constructing a 12,000-ft. pipe line up the walls of the Grand Canyon, the Atchison, Topeka & Santa Fe is now supplying water to its own facilities and those of the United States Government Park Service at Grand Canyon, Ariz., from springs located 3,153 ft. below the rim of the canyon. Thus, the railroad has finally ended the costly water haul in tank cars from Flagstaff, Ariz., 98 miles away, and other distance points which has challenged its engineers for years. Because of the high lift, and the steep and rugged nature of the canyon wall the consummation of this project required the application of unusual methods in constructing the pipe line, while the centrifugal pumps that were installed to lift the water represent a new departure in the handling of water against high heads. The line extends up the canyon wall on an average grade of 45 per cent with one vertical cliff 280 ft. high.

The water supply is obtained from springs located at Indian Gardens, on the Bright Angel trail from the rim to the Colorado river. From the rim of the canyon the Indian Gardens appear to be on the canyon floor although actually they are located on a natural bench about 1,200 ft. above the river. The two main springs empty into a 70,000-gal. reservoir, 38 ft. in diameter and 10 ft. deep, to which water from other springs is also delivered by two vertical turbine pumps through a 6-in. cast-iron pipe line from a supplemental submerged dam and concrete sump, which was constructed at the lower end of the wooded area at a level 200 ft. lower than the main reservoir.

The water is lifted by four vertical turbine-type centrifugal pumps which are located in a pumphouse at the reservoir, making one lift to a water tank on the rim of the canyon. These pumps, which operate against a pressure of 1,470 lb. per sq. in., were especially designed to fulfill the requirements imposed by the conditions existing at this location. The pumps are hung on I-beams supported over a concrete pit sunk below the floor of the pumphouse, and are designed to operate in pairs, forming the equivalent of two 34-stage pumps. Each of the double units is designed to handle 85 g. p. m. against a head of 3,400 ft.

Automatic Control Apparatus

A notable feature of the pumphouse is the control apparatus provided, which includes a large switchboard embodying an elaborate automatic panel and a supervisory control which is connected by means of a separate signal cable with a master panel located in the power house on the rim of the canyon. This arrangement allows the operator in the powerhouse to start and stop the pump, or open and close valves by push-button control, thereby making it unnecessary to provide attendance at the pumphouse. It is planned to operate the plant with only a weekly inspection, thus reducing labor costs to a minimum.

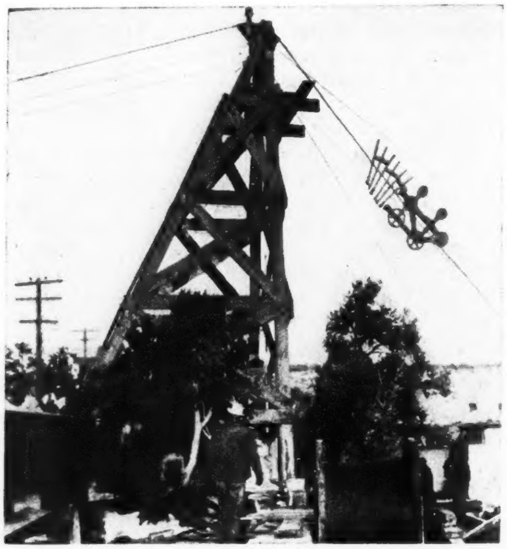
The automatic control equipment includes a two-inch hydraulically-operated and electrically-controlled gate valve which is provided on the discharge side of each pump. The header connecting the two pumping units discharges through a 3-in. needle check valve

Above—The Pipe Line Traverses a Vertical Cliff 280 Ft. High. Right—A Portion of the Cableway, Showing Two Towers

with a motor-operated adjustment for regulating the flow to a definite quantity. The equipment also includes a two-inch automatic relief valve with a relief line to the reservoir and a motor-operated drain valve for emptying the pipe line if necessary. Freezing of the small control pipes in the winter is prevented by a thermostatically-controlled electric heating system. The pumps at the collecting dam are automatically controlled by float switches in the reservoir.

Seamless Steel Tubing Used

The pipe line consists of 6-in. galvanized seamless steel tubing with upset ends, the sections being connected by forged steel couplings with rubber gaskets. The pipe in the upper section of the line has a wall thickness of 0.28 in., to withstand a maximum pressure



On the Canyon Rim, Showing the Head Tower of the Cableway

of 1,000 lb. per sq. in. Pipe having the same external diameter but with a wall thickness of 0.3125 in. was used in the lower section of the line, which is under a maximum working pressure of 1,470 lb. per sq. in. The sections of pipe average 30 ft. in length and all pipe bends were made cold in the field with screw jacks. The pipe is galvanized both inside and out and where it is covered it is given protection with various rust-proof coatings and is wrapped.

Required to Conceal Line

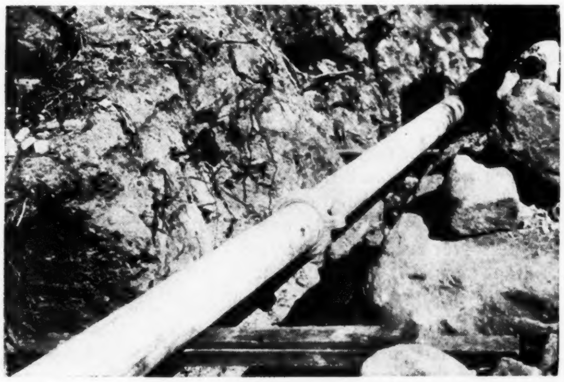
The difficulties of constructing the line were complicated by the requirements of the Park Service that as much of the line as possible be concealed from view, and for this reason the line was covered at all locations, except where it rises against the face of perpendicular cliffs. In addition, the use of overhead power transmission wires was prohibited and it was necessary to bury the electric cables in the trench with the pipe line.

Where the line traverses rocky cliffs it is fastened to the rock by means of steel anchors. At certain locations where falling rocks are apt to damage the pipe line it is protected by a half-round steel housing made by splitting a 13½-in. steel casing longitudinally, which is fastened over the pipe line by means of U-bolts.

No insulation is provided on the pipe line where it is exposed on the cliffs, but is painted a color matching that of the rocks, although the temperature in the winter may reach 20 deg. F. below zero. Protection, however, is provided by an electric thermostat located at the coldest point near the rim of the canyon which gives a warning signal in case the temperature gets too low, so that the water flow can be maintained or the line can be drained in order to safeguard it against damage.

Preparatory to the construction of the pipe line it was necessary to construct a complete cableway system for the transportation of materials down the canyon wall, and as the transportation of men on mules down the Bright Angel trail was too slow and expensive, the cableway was used to a large extent for the movement of men. Owing to the height and irregularities of the walls, such a system required the construction of four spans, end to end, varying from 600 ft. to 2,500 ft. in length, embodying four hoists and transfer points. In this cableway system the track cables were 1½ in. in diameter, the traction cables ¾ in. and the load line ⅝ in. A remarkable fact incident to the erection of this system is that it was constructed in below-zero weather without any serious accidents.

In addition to facilitating the transportation of materials and men, this cableway made it possible to land them very close to any desired point along the location of the line. Furthermore, it permitted the ready handling of five-ton reels of electric cable, although for a portion of the line the electric cable was pulled into place along a series of temporary wooden rollers, spaced at frequent intervals along the pipe trench.



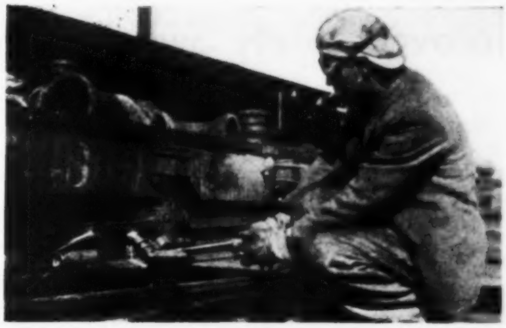
View of a Typical Section of the Pipe Line, Showing a Coupling

To insure that the water will be suitable for hotel and railroad use when delivered to the storage tanks on the rim, a zeolite water-softening plant, combined with chlorinators, was installed in the powerhouse on the rim.

This project was carried out under the general direction of M. C. Blanchard, chief engineer of the Coast Lines of the Atchison, Topeka & Santa Fe, while G. L. Davenport, Jr., assistant engineer, was in charge of the design of the pumping plant and also exercised general supervision over the construction work. J. M. Terrass, assistant engineer, was in direct charge of the construction work in the field.

Freight Traffic—Freight traffic handled by the Class I railroads in the first two months of 1933 amounted to 38,997,692,000 net ton-miles, a reduction of 5,433,108,000 net ton-miles, or 12.2 per cent, under the corresponding period in 1932, according to reports compiled by the Bureau of Railway Economics.

Cropping of Rail Ends Is Effective



Making a Typical Cut, With the Torch Held in a Special Guide Block to Insure a True Square Rail End

Experience on two jobs covering 32 track miles indicates that gas method is economical and does not result in damage to the metal

THE question of whether rails can be cropped satisfactorily and economically with the acetylene torch, at least in large scale operations in the field, has been answered in the affirmative on the Atlantic Coast Line, where, on two occasions, 15 or more track miles of relay rails have been cropped in the field, with satisfactory results in regard to both the cutting operations themselves and the service of the cropped rails under traffic. In 1930, 17 track miles of 70-lb. rails were cropped by means of the torch, and during the summer of 1932, 15 track miles of 85-lb. rails were cropped in the same manner, in both cases at a cost of approximately 12 cents per cut for labor and gases. It is reported that no special difficulties were involved in either piece of work; that so far as can be determined the heat of the torch in no way damaged the rails; and that there has been no more chipping or battering of the cropped rails than is experienced in the case of uncropped rails.

Details of Latest Work

In the more recent work 15 track miles of 85-lb. A. S. C. E. rail, with approximately 25 years service in mail line tracks, was being relaid on the Walterboro branch between Walterboro and Ehrhardt, S. C. Since the ends of the relay rails were not in good condition with respect to batter and fishing wear, it was decided, based on the successful results of earlier work of this character, to crop them in the field by the torch method.

The rails to be laid were, for the most part 33 ft. long and were drilled for six-hole joints. In the cropping, five inches was removed from each end, which left the rails suitable for the application of four-hole bars, or for the reapplication of the old six-hole bars, utilizing, however, in the case of the latter, only the four center bolt holes. Finding the old bars in fair condition, most of them were used in the relaying work, and the balance of the requirement was made up of four-hole relay bars.

In anticipation of the cropping work, the relay rails were lapped at the ends as they were distributed along the track, the amount of lap being approximately 10 in., or sufficient to allow for the end cut-offs, thereby avoiding the necessity for moving the rails back as they were placed in the track later. At the time of the cropping work, which was done with a force consisting of a torch operator, a helper, and four laborers, the rails were set upright on two 7-in. by 9-in. blocks, one near each end. The cutting was done with a standard cutting torch and with a special guide block which was placed on the rail to insure true vertical cuts. In this work, the cuts were made continuously through the rail, usually from the base upward through the head. The gases and apparatus used were furnished by the Oxweld Railroad Service Company, and the cylinder containers were moved from rail to rail in a special hand truck which could be operated equally well on the track shoulder or on one of the track rails. Each cut required approximately one minute, and the cost per cut, including labor and gases, amounted to approximately 12 cents.

In the earlier torch cropping work on the Atlantic Coast Line, 17 track miles of 70-lb., A. S. C. E. and Pennsylvania section rails were involved, which were being relaid on the Pregnalls branch, between Creston and Eutawville, S. C. In this work, in which the rails had been drilled originally for four-hole bars, the crops took from 12 to 18 in. off the ends and new holes were drilled for the application of reclaimed four-hole bars. The actual cutting was done in much the same manner as on the Walterboro branch, while the drilling was done with a gasoline engine-propelled, single-bit drilling machine, after the rail had been set upright on blocks.

The force on this earlier cropping work included a mechanic, who operated the torch, and two laborers, one of whom assisted the mechanic and handled the cutting guide, while the other kept the gas cylinders moved ahead on a push car. Other men did the drilling in a follow-up operation.

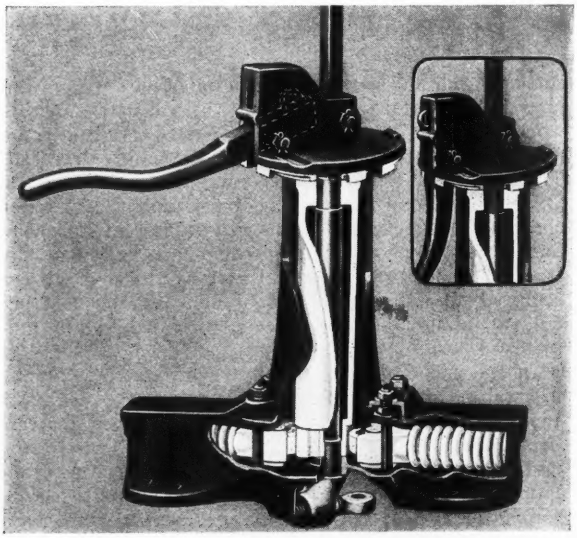
The cost of the cropping and drilling in the earlier work were not kept separate so that it is impossible to determine the exact cost of the rail cropping alone. However, the combined work of cropping and drilling, including all handling of the rail in connection therewith, cost approximately 27½ cents per rail end.

There is a feeling on the Atlantic Coast Line that the cropping and drilling of the rails in the field is somewhat slower than similar work done at a central plant, especially the drilling, but it is recognized that doing the work in the field saves at least one handling, and frequently considerable road haulage, of the rails. Largely improved track conditions were obtained through the rail cropping described, and, as stated at the outset of this article, observation of the cropped rails in the track indicates that they were in no way damaged by the heat of the torch.

The rail cropping on the Pregnalls branch in 1930 was done under the direction of J. B. Trenholm, engineer maintenance of way at Rocky Mount, N. C., while the work last year on the Walterboro branch was carried out under the direction of E. B. Hillegass, engineer maintenance of way at Savannah, Ga.

Improved Safety Switch Stand

THE Ramapo Ajax Corporation, New York, is now offering an improved model automatic safety switch stand, Style 17-B, for main line use, which incorporates a number of substantial improvements. The improved model maintains all of the essential features of the old Style No. 17:—A resilient connection to the switch points, permitting trailing movements through a wrongly set switch with perfect safety; positive hand throw, the target always indicating the true position of the switch points; and removable cover plates at each end, making possible ready inspection and oiling of moving parts.



Cut-Away View of the 17-B Switch Stand, Showing Essential Features of its Construction

In addition, the new model has fewer parts; the wearing parts have been given a better and more substantial fit, minimizing lost motion; and true alinement has been insured for the lamp and target in either position. The sliding sleeve of the old Style 17 stand has been eliminated.

In the improved model, the key to the improvements made lies in the simpler relation provided between the spindle, the star block at its base, and the operating or throwing lever. When a car or locomotive trails through a switch set against it, the forward wheel closes the open point to make gage. This movement of the switch points is transferred through the connecting rod to the star block at the base of the spindle. The star block, in turn, rotates, rotating the spindle with it, and thus the target, but without disturbing the hand operating lever in its locked position.

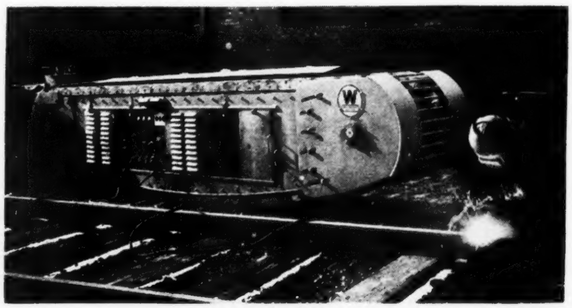
The star block, as in earlier models, rotates against two rollers, forced against opposite sides of the block by heavy coil springs. As the switch points are forced over by the leading car or locomotive wheel, the star block, in rotating, compresses the springs holding it, and when the points are approximately half thrown, and thereby the star block likewise, the compressed springs expand and exert their pressure against new sides of the star block, forcing the switch points to full throw, which otherwise might not be accomplished by the wheels alone. Being fixed to the spindle during automatic operation, the positive 90-deg. rotation of the star block also insures positive 90-deg. rotation of the target and switch lamp, with accurate focus in the new position.

In throwing the switch by hand, the operating lever is unlocked and raised, and can then be rotated in a horizontal plane, throwing the switch points in the usual manner. When the switch is thrown by hand, the raising of the operating lever disengages the spindle from the star block, so that manual operation does not require overcoming the resistance of the springs holding this block against rotation. The lowering of the operating lever into locking position and thus re-engaging the spindle and star block, are not possible until the movement of the switch has been completed, making operation by hand positive.

It is claimed that the resilient connection between the locked switch stand and the switch points greatly minimizes vibration strains transmitted to the stand, offering protection against fatigue of metal, crystallization and failure of connections, and that through this factor and the sturdy design incorporated in the stand, the life of the 17-B in busy locations will average five times as long, without repairs, as that of rigid type stands in the same locations.

Track Welding Generator Mounted in Tractor

TO MEET the need for a mobile welding generator for use in its track welding work, which does not require frequent transferring to and from the track, and which can move or stand on the track shoulder, in the clear of trains, the Lehigh Valley, last year, developed and built an ingenious tractor mounting for one of its welding generators. This unit proved so effective in service that the road immediately placed an order with the Westinghouse Electric & Manufacturing Company for the construction of six more machines, fully equipped, and in many respects an improvement on the original machine.



One of the Six New Tractor-Mounted Welding Generators Built by the Westinghouse Company

The new tractor mountings consist essentially of a supporting steel framework, the sides of which are enclosed with heavy steel plate, and link tractor treads on each side, operating over sprockets at each end. The tractors are 15 ft. long, and are only 31 in. wide and 36 in. high, permitting their operation on the track shoulder in the clear of trains. It is said that they can ascend slopes of 35 deg. and are stable in operation on side slopes of 45 deg.

All of the power units are assembled within the tractor housing and include essentially a Buda 6-cylinder, 65-hp. gasoline engine; a Westinghouse FlexArc 300-amp. welding generator; an auxiliary 7½-kw. genera-

tor, compound wound, for supplying direct current for the operation of grinders, slotters, other tools and lights; and two 5-hp. propulsion motors, which take their current from the welding generator. The gasoline engine is mounted in the forward end of the tractor, with its fuel tank directly overhead. The welding generator lies directly behind the engine and is direct-connected to it, while the auxiliary generator is built into the same frame as the welding generator and operates on the same shaft.

The two propulsion motors are mounted on a removable bulkhead in the rear of the tractor frame and are separately geared to the drive sprockets of the link treads, which are entirely independent of each other. The speed of the motors is regulated by varying the field excitation of the welding generator by means of a rheostat. Hand-operated drum switches, one for each motor, provide for the direct control of the tractor movements, whether forward or backward, in a straight line or in making turns.

The control equipment for both the welding and auxiliary generators is mounted on a panel alongside the generators, and is reached through a sliding door in the

One of the New Tractor-Generators Crossing Tracks

side of the tractor housing. Other openings with doors give access to the vital parts of the gasoline engine for adjustment and oiling. Through their mounting on a removable bulkhead, both drive motors can be readily removed for inspection or repair, together with the tread drive sprockets and gear connections.

The new tractor-mounted welding generators are being used in all classes of track welding, and, owing to the FlexArc feature of the generator, permit welding with both bare electrodes at the lower voltages and coated electrodes at the higher voltages. A gang of four men is usually employed with each machine, including a welder, a grinder operator, a tractor operator and joint slotter, and a flagman.

Relatively short cables are used with the tractors, these providing for the welding of 12 joints (both rails) in 39-ft. rail territory, between moves. While this necessitates frequent movement of the tractors, the moves are made by one man, in a few minutes, who, when not engaged in making the moves, does all of the slotting of the newly welded joints. The tractors can make pivot turns about a central axis and can readily climb over tracks and load and unload themselves on a flat car or push truck by means of two timbers placed to form a ramp. The weight of the complete units is approximately five tons.

The tractor-mounted welding generator was developed under the general direction of G. A. Phillips, chief engineer maintenance, Lehigh Valley, and the first unit was designed and built under the direct supervision of C. A. Miller, supervisor of frog shop and roadway tools.

Rail Output Drops in 1932

THE production of rails in the United States in 1932 totaled 402,566 gross tons, the lowest output for any year since 1866, when 384,623 tons of rails were produced, according to figures prepared and released by the American Iron and Steel Institute. Another measure of the low rate of production last year is afforded by the fact that the output in 1932 was only 10.1 per cent of the production in the record year of 1906, and 34.8 per cent of the production in 1931. The trend toward heavier rails is demonstrated by the fact that the production of rails weighing 100 lb. or more per yard in 1932, which was 343,613 tons, represented 85.3 per cent of the total, as compared with 76 per cent in 1929. However, in 1932 the production of rails weighing 120 lb. or more per yard amounted to only 128,523 tons, or 29.4 per cent of the total, as compared with 40 per cent in 1931, this being the first time since rails weighing 120 lb. per yard or over have been tabulated separately that a decrease has occurred in the proportion of the total represented by these rails.

The production of rails rerolled from defective rails and from old rails last year amounted to 9,488 tons as compared with 21,372 tons in 1931 and 139,742 tons in 1923. That Bessemer rails now constitute a negligible factor in rail production is indicated by the fact that only 64 tons of these rails were rolled in 1932. Although there was an increase in the tonnage of alloy steel rails, produced from 533 tons in 1931 to 565 tons in 1932, the total is small compared with that of 1930, when 4,687 tons of alloy steel rails were rolled.

Production of Rails by Processes, Gross Tons, 1917-1932

Years	Open-hearth	Bessemer	Electric	Rerolled*	Total
1917	2,292,197	533,325	......	118,639	2,944,161
1918	1,945,443	494,193	......	101,256	2,540,892
1919	1,893,250	214,121	50	96,422	2,203,843
1920	2,334,222	142,899	297	126,698	2,604,116
1921	2,027,215	55,559	5	96,039	2,178,818
1922	2,033,000	22,317	......	116,459	2,171,776
1923	2,738,779	25,877	118	139,742	2,904,516
1924	2,307,533	16,069	......	109,730	2,443,332
1925	2,691,823	9,687	......	83,747	2,785,257
1926	3,107,992	12,533	......	97,124	3,217,649
1927	2,717,865	1,566	......	87,055	2,806,486
1928	2,580,141	2,718	438	64,196	2,647,493
1929	2,626,163	3,486	723	55,766	2,722,138
1930	1,834,933	2,137	45	36,118	1,873,233
1931	1,145,551	813	15	21,372	1,157,751
1932	393,014	64	......	9,488	402,566

*From old steel rails.

Production of Rails by Weight Per Yard, 1917-1932

Years	Under 50 pounds	50 and less than 85	85 and less than 100	100 and less than 120	120 pounds and over	Total gross tons
1917	308,258	882,673	989,704	763,526		2,944,161
1918	395,124	665,165	888,141	592,462		2,540,892
1919	263,803	495,577	965,571	478,892		2,203,843
1920	489,043	433,333	952,622	729,118		2,604,116
1921	211,568	214,936	902,748	849,566		2,178,818
1922	265,541	274,731	728,604	902,900		2,171,776
1923	272,794	300,907	864,965	1,465,850		2,904,516
1924	191,046	213,274	853,431	1,175,581		2,433,332
1925	163,607	219,648	765,371	1,636,631		2,785,257
1926	197,260	256,287	797,662	1,966,440		3,217,649
1927	161,836	173,257	539,445	1,314,424	617,524	2,806,486
1928	134,197	125,726	465,393	1,203,749	718,428	2,647,493
1929	141,362	102,944	409,628	1,233,599	834,605	2,722,138
1930	95,626	81,299	267,879	835,496	592,933	1,873,233
1931	50,089	25,524	123,398	495,752	462,988	1,157,751
1932	16,655	13,705	28,593	215,091	128,522	402,566

Production of Alloy-Treated Steel Rails, 1922-1932

	Total production.	Production by alloys		Production by Processes		Production by weight per yard				
Years	Gross tons	Titanium	Other alloys	Open-hearth and elect.	Bessemer	Under 50 lbs.	50 and under 85 lbs.	85 and under 100 lbs.	100 and under 120 lbs.	120 lbs. and over
1922	3,163	2,493	670	3,163	......	......	321	835	2,007	
1923	2,142	346	1,796	2,142	......	......	56	317	1,769	
1924	5,167	1,696	3,471	5,167	......	......	......	847	4,320	
1925	4,009	1,616	2,393	4,009	......	70	47	......	3,892	
1926	4,216	1,099	3,117	4,216	......	......	42	1,027	3,147	
1927	1,265	......	1,265	1,265	......	......	......	374	391	500
1928	6,453	3,711	2,742	6,453	......	29	......	879	1,652	3,893
1929	1,965	486	1,479	1,965	......	100	......	748	967	150
1930	4,687	517	4,170	4,687	......	146	......	885	1,137	2,519
1931	533	......	533	518	15	......	......	282	232	19
1932	565	......	565	565	......	......	......	75	490	......

What's the Answer?

Have you a question you would like to have someone answer?

Can you answer any of the questions listed in the box?

To Be Answered in July

1. *How soon after insertion should a new tie be spiked? Why? Does the kind of ballast or the use of tie plates make any difference?*

2. *For what period should bridge timbers be air-seasoned before treatment? Why? Does the kind of wood or time of year make any difference? What are the effects of overseasoning? Of underseasoning? How can the checking of timbers be overcome?*

3. *When ballasting, or making a general raise without applying new ballast, and renewing ties, should the track be lined ahead of the surfacing? Why? How closely behind the surfacing should the final lining follow?*

4. *Where a long discharge line is being laid in undulating country, what precautions should be observed to avoid excessive pump pressures and insure dependable delivery of water at the tank?*

5. *What is the minimum allowable distance between switch points and the nearest joints in advance? Why? Does the length of rail or of the switch points make any difference?*

6. *What methods other than the use of treated lumber can be employed to minimize decay below the floor level in frame buildings?*

7. *With what kinds of ballast is it practical to tamp ties from the end by means of a wide, thin blade? What are the advantages and disadvantages, as compared with pick or shovel tamping? What are the limitations of this method?*

8. *Should bridge seats be kept clear of dirt and cinders? Why? If so, who should be required to do this?*

Anti-Creepers Through Turnouts

What are the advantages, if any, of applying anti-creepers through main-line turnouts? Through yard turnouts? How should they be placed **?**

Rail Creepage Distorts the Turnout

By W. E. TILLETT
Assistant Foreman, Chesapeake & Ohio, Maysville, Ky.

Since rail tends to creep under heavy motive power and cars and any such movement through a turnout tends to distort the entire assembly, throwing it out of line and affecting the gage, particularly at the frog and switch points, it becomes important to prevent this movement, especially where high-speed trains are operated. The only practicable means that I know of for doing so is by applying anti-creepers. It is not enough to anchor the track approaching the turnout, although this is very necessary. Neither is it sufficient to apply the anti-creepers through the turnout only. They should be applied both through the turnout and for such distance beyond as may be necessary to overcome the tendency of the rail to creep.

In general, the method of applying the anti-creepers through the turnout will depend on the conditions surrounding its use. It may be necessary to anchor both the running and the turnout rails where a heavy traffic is diverted from the through route, as at junctions, ends of double track, entrances and exits to yards and frequently-used crossovers and sidings. In many instances, the anchorage should extend a sufficient distance back of the frog on sidings, yard leads, etc., to insure that there will be no movement of the rail that will push or pull the frog out of line or cause the rail to shift with respect to the points. In any event, sufficient anchors should be applied through the turnout to insure that it will be held rigidly against internal movement.

Line and Gage Easier to Maintain

By J. J. DESMOND
Division Engineer, Illinois Central, Chicago

By applying anti-creepers through main-line turnouts, we find that we can better maintain the line and gage at the frog and switch points. In double-track territory, anti-creepers should also be applied in the direction of traffic for some distance on either side of a turnout; on single track, in both directions. These applications should be balanced, however, because if an insufficient number of anchors are applied away from the turnout and a surplus through the turnout, the turnout is called upon to resist the creeping of the main-track rails. When the main track away from the turnout is properly anchored, the anchoring of the turnout becomes less difficult.

For facing-point crossovers between main tracks, I consider the use of anti-creepers very necessary, as the creeping of the rail tends to crowd the crossover from both directions. If the crossover is trailing, it is likewise good practice to anchor the entire crossover in both directions to avoid the pulling of the joints apart as well as to protect the frogs and switches against heavy strain.

Extreme care should be exercised in applying the anti-creepers. They should not be closer than the third tie from a joint and should not be placed on both sides

of a tie, since even a slight movement of the rail may cause churning. On single track, the installation should extend back into the siding, the number of anchors and the distance depending on the tendency of the rail to creep.

Yard turnouts require little anchorage, except where the traffic is largely in one direction or where heavy, fast switching is performed. Yards and sidings where the traffic is about equal in both directions, with some exceptions because of location, grades, etc., generally require little anchorage and the decision as to the application of anti-creepers must be based on the local conditions.

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Centrifugal Pumps

What fluctuations are permissible in the head against which a centrifugal pump must work? What are the effects of wider variations

Fluctuations of 10 to 15 Per Cent Allowable

By J. H. DAVIDSON
Water Engineer, Missouri-Kansas-Texas, Parsons, Kan.

Assuming that the speed of a centrifugal pump remains constant, any increase in the head against which it is working will result in a decrease in the quantity of water discharged in a given time. As the head is increased, the quantity discharged gradually decreases until a head is reached against which no water will be discharged. As the head increases and the discharge decreases, the brake horsepower required decreases. Thus, for every centrifugal pump there is a definite head at which it develops the greatest efficiency; that is, the point at which the ratio of the water horsepower to the brake horsepower is greatest. As the head is increased above the point of maximum efficiency, the efficiency gradually decreases until at the head against which no water is discharged, it becomes zero.

Now, if the head against this pump is gradually decreased, the quantity of water discharged in a given time increases, the brake horsepower is increased and, after the point of maximum efficiency is passed, the efficiency will decrease. This increase in discharge and increase in power required will continue as the head is decreased until the maximum quantity of water which the pump is capable of handling will be discharged.

From the foregoing it will be seen that the head against which a centrifugal pump is operating at constant speed can be increased to the point where the pump will deliver no water, and that the effect of increasing the head is to decrease the quantity of water pumped and greatly reduce the efficiency, but there is no danger of injury to the equipment. Conversely, if the head is decreased too much, the increased quantity of water handled and the consequent increase in power used may result in overloading the motor driving the pump, unless both the pump and motor were properly selected to avoid this.

To illustrate the effect of changing the head against which a centrifugal pump driven by a constant-speed motor is working, let us consider the case of a small pump which has its maximum efficiency when working against a head of 40 ft. At this point it delivers 100 gal. per min., requiring 1.9 brake hp., with an efficiency of 54 per cent. Against a 45-ft. head, the delivery will be 62 gal. a min., the brake horsepower 1.25 and the efficiency 43 per cent. Against a head of 48 ft., no water will be discharged, the brake horsepower will be approximately 1 and the efficiency zero. Now, if the head is decreased to 35 ft., 125 gal. a min. will be delivered, requiring 2.1 brake hp. and the efficiency will be 45 per cent. If the head is decreased to 25 ft., the discharge becomes 153 gal. a min., the brake horsepower 2.4 and the efficiency 40 per cent.

It will be seen, therefore, that if we have this pump operating at its point of greatest efficiency and increase the head 7.5 per cent, the quantity of water pumped will decrease 25 per cent and the efficiency 9 per cent. A decrease of 12.5 per cent in the head below that for maximum efficiency will result in an increase of 25 per cent in the quantity of water handled and a decrease of 9 per cent in efficiency. The fluctuation in power required between these changes in head is 0.5 hp. If this pump is, therefore, powered with a 2-hp., constant-speed motor operating at 1750 r.p.m., fluctuations in the head of from 10 to 15 per cent from the point of maximum efficiency will not result in too great a loss of efficiency or overload the motor.

Pump manufacturers test their centrifugal pumps and from these tests develop what are termed head capacity, efficiency and brake-horsepower curves. These are referred to as "characteristics," and from them it is easy to determine just what the performance of the pump will be under any set of conditions. From them the most efficient pumping unit for the given conditions can be selected. The motive power should be of sufficient size or flexibility to take care of the most extreme changes in head and power requirements that may be encountered under the given conditions.

The ideal condition for the operation of a centrifugal pump driven by constant-speed motive power is to maintain a constant head at the point where the greatest efficiency is obtained. Generally, however, fluctuations of 10 to 15 per cent in head can be allowed with safety with well-designed centrifugal pumps without too great a loss in efficiency or danger of overloading the motor. Greater variations can be cared for by providing variable-speed motive power, such as steam turbines, steam engines or variable-speed electric motors.

Depends on the Type of Pump

By J. R. HICKOX
Hydraulic Engineer, Chicago, Burlington & Quincy, Chicago

There are several types of centrifugal pumps, among them the old impeller type which is still used quite extensively for various purposes. The head against which this type will operate successfully is determined by the speed in revolutions per minute. The characteristics of this type are such that if the pump is operated at a uniform speed, the quantity of water handled increases as the head decreases, and the quantity increases faster than the head decreases. Since the horse power required to operate the pump is the product of the pounds of water handled in one minute, multiplied by the number of feet lifted, divided by 33,000, the horse power required increases as the head decreases. There have been many cases where fuses have been blown or motors burned out when the head has been reduced suddenly, as by the bursting of a pipe, or when starting a pump with the discharge line empty.

In the volute type of pump much of this trouble is overcome in the design. These pumps are generally designed to deliver a given quantity of water against a known head. They have their greatest efficiency when working against this head at the speed for which they are designed. As a rule, however, they can be operated

without a very great loss of efficiency against lower heads. The design is such that the quantity of water does not increase as fast as the head decreases, so that there is no danger of burning out the motor. The maximum horse power required is nearly at the point of greatest efficiency of the pump.

To put it briefly, with the impeller type of pump, operating at constant speed, the amount of water pumped decreases as the head increases and the power required by the pump decreases correspondingly. On the face of it, this does not sound as if it is correct. But when we remember that the quantity of water decreases faster than the head increases, we can readily understand why this is so. The pump can be operated anywhere within the limits of the head against which it is able to work if the necessary power is applied to it. With the volute type, the design of the pump determines the quantity of water it should handle and the head against which it should work. This pump can be operated so as to handle not more than 50 per cent of what it was designed for, by giving it the proper speed, without losing very much of its efficiency. It can also be operated over quite a wide range of head without seriously impairing its efficiency, which means that with this type of pump, the power required over quite a wide range of operating conditions varies almost directly with the head.

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Cleaning the Cribs

When cleaning ballast, under what conditions does the advantage of cleaning the cribs justify the cost of doing this **?**

Pays to Do So When Renewing Ballast

By E. A. CRAFT
Engineer Maintenance of Way, Southern Pacific, Houston, Tex.

Generally speaking, dirty ballast, with attendant obstruction of drainage, results from the material not having been clean when it was applied, or from disintegration due to the action of the elements or to mechanical wear from tamping or traffic or both. Where cleaning is undertaken to improve the drainage of the existing ballast, and only such new ballast is used as is necessary to restore the section, one is not justified in incurring the expense for cleaning the cribs more than 8 or 10 in. inside of the rail. Where the track is given an out-of-face raise, we consider it desirable and the expense justified of cleaning the cribs entirely; otherwise, there will be more or less of the dirty material in the cribs between the rails which will become mixed with the new, clean ballast that is used in making the raise, and some part of the benefit of the new material is lost.

Cribs Should Be Cleaned

By I. H. SCRAM
Engineer Maintenance of Way, Erie, Jersey City, N. J.

Cleaning stone ballast is a comparatively recent problem that has become acute since modern locomotives with their mechanical stokers and burning small sized fuel have intensified the fouling of the ballast. Higher speeds also increase stack losses, with resulting heavier deposits of cinders to clog the ballasts, stop drainage and induce pumping ties and churning ballast. Since the ballast section between the ends of the ties provides the support for the track, the question of handling the material in the cribs before raising track is a pertinent one.

In recent years ballast-cleaning equipment has been developed for the shoulders and inter-track spaces. Since the volume of ballast in the inter-track space is generally about one-third of that on the shoulder, the cost of cleaning the ballast in the crib is substantially that of clearing the cribs and throwing it into this space, since most ballast-cleaning machines operate at a fixed speed. The cost of clearing the cribs is about $0.05 a foot of track. The cost of cleaning the ballast by machinery is about $0.08 a foot. The increase is, therefore, not great, especially when compared with the cost of reballasting, and its advantages may be weighed accordingly.

Originally, stone ballast was not cleaned, the track generally being raised as with cinder and gravel ballast. With heavier wheel loads, however, the dirty ballast placed under the ties churned. Hand cleaning was attempted, but proved to be too expensive. When ballast-cleaning machines were introduced, the inter-track space was first cleaned and later the shoulder was included. It was thought that this would provide space into which the fine material under and between the ties would be washed. This was realized to some extent but not enough and the finely divided material under the ties caused the usual pumping action when wet, particularly when the track was raised without cribbing. Obviously, the cure was to remove the ballast from the cribs, raise on clean stone and thereby get a layer of clean porous material between the tie and the old bed. In practice, this has worked. The track remains dry and in good surface without heavy work. It is apparent, therefore, that in heavy-duty track, all stone ballast should be cribbed and cleaned before the track is raised.

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Material from Ditching

What disposition should be made of the material obtained from cleaning out side ditches through cuts in the spring? Of the material left when installing permanent drains in cuts? What methods should be employed **?**

Should Be Used on Embankment Shoulders

By E. H. PIPER
District Maintenance Engineer, Chicago, Burlington & Quincy, Lincoln, Neb.

Conditions affecting this problem vary on different railways and in different localities on most roads. Some have done much more ditching of cuts and widening of embankments than others, and consequently have roadbeds of suitable width, so that the material now obtained from ditching is not needed for widening banks. On some of the western roads, the embankments are still quite narrow; in fact, some are too narrow to support the ballast section properly. A wide embankment is necessary for the stability of the track structure. If the roadbed is narrow, the track readily whips out of line and is difficult to maintain. In my territory all material obtained from the cleaning of ditches is hauled out in dump cars and utilized for widening embankments. In many other localities this can doubtless be done to advantage.

The economical method of hauling is through the use of dump cars, using either ditchers in work trains or locomotive ditchers to do the loading. Where material is not suitable for widening the shoulders or is

not needed, the question of its disposition is another matter. It would seem that in such cases the local conditions should govern and each be decided on its merits, since in many instances it might be a difficult and expensive operation. Wet, sticky gumbo is unsuitable for bank widening, particularly when left high on the shoulders, since the ballast section will become boxed and soft spots form. Without question, adequate and proper drainage is the secret of good track. For this reason, any material from ditches for deposit along embankments should be carefully selected and properly placed.

Material left from the installation of drains in cuts should by all means be hauled out, for if left in the cuts, it will interfere seriously with the drainage, thus defeating the purpose of the installation. Generally, no great quantities are involved so that the expense of removal is nominal. The same method of disposition may be used as in the cleaning of cut ditches.

Would Place It on Embankments

By G. M. HELMIG

Bridge and Building Department, Missouri Pacific, Wynne, Ark.

In general, material obtained from cleaning out side ditches in cuts should be used to restore the standard sections of embankments adjacent to the cuts. This also applies to material left when installing permanent drains in cuts. Both experience and observation lead me to believe, however, that the stabilizing of soft, wet cuts by the removal of considerable excess material by means of ditching machines and air dump cars is the most economical and effective way of handling the dirt as well as of eliminating the ditching nuisance.

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Removing Stringers

What is the best method of removing stringers from a trestle that has been filled? What precautions should be observed? Should the caps be removed also? Why ?

Depends on Traffic and Equipment Available

By H. AUSTILL

Bridge Engineer, Mobile & Ohio, St. Louis, Mo.

The answer to this question depends entirely on the density of traffic and the equipment available. The principal precautions to be observed include waiting until the fill has compacted enough so that there will be no danger of rapid settlement after the track load has been transferred to it; insuring that the frost is out of the ground; and that the filled material is fairly dry. If the interval between trains is short, the center should first be filled and the ties tamped a reasonable amount. The stringers should then be shifted outward to the ends of the ties and the filling and tamping extended while the ties still have a bearing on the stringers. The next shift is to remove the stringers and allow them to slide down on the fill where they can be salvaged after unbolting. If the ties are dapped over the stringers, the track must first be raised enough to allow a shim to be placed between the ties and stringers. If a light locomotive crane is available and the time between trains permits its use, much time can be saved by using it to shift and salvage the stringers.

Since the top filling material is usually placed by train, thus making a locomotive available, I have often found that the quickest method of removing stringers from a long trestle is to use cinders for the top filling. We then cut the stringers into sections of about 100 ft., remove a few ties at one end and, fastening a cable to the end of a section, drag it out along the track with the locomotive. I have never used an off-track machine for such work, but a tractor could be used in place of the locomotive to drag the stringers out. My practice has been to remove the guard timber but leave the trestle ties in place to serve the remainder of their life as track ties.

The decision as to whether the caps should be removed resolves into a matter of balancing the cost of removal against the salvage value. As already stated, the fill should be allowed to settle well before removing the stringers. If this is done, the caps will cause no trouble if left in place. On the other hand, if it becomes necessary to remove the stringers from a green fill, the caps should also be removed.

Caps Should Be Removed

By R. H. GILKEY

Division Engineer, Central of Georgia, Savannah, Ga.

We find that the best method is to cut the filling away from the outside of the stringers and work them to the outside one at a time, thus allowing trains to pass up to the point of removing the last stringer. The filling is shoveled into the space left by the stringers and compacted as soon as they are out. Careful removal in this manner from both sides of the trestle at the same time eliminates the hazard of turning cars over, which would be likely to occur if the two chords are removed at different times. The caps should be removed also. In addition to the fact that some salvage will be obtained, caps that are allowed to remain eventually decay and soft spots frequently develop in the fill as a result. Again, where they are left, they may permit an opening which, if filled with water, will greatly increase the hazard of a washout or slide.

Crane with Clamshell Most Successful

By L. G. BYRD

Bridge and Building Supervisor, Missouri Pacific, Wynne, Ark.

Filled bridges usually cause considerable delay to traffic and are expensive to maintain while the fill is settling. Formerly, it was necessary to carry them for a long time to permit sufficient settlement to make it possible to remove the timber and support the track on the new fill. This was due to the method of removing the stringers, which as a rule was done by hand and was very expensive. Recently, this problem has in large measure been solved by using a crane equipped with a clamshell bucket.

This method requires little hand labor. We have filled more than 22,000 lin. ft. of trestles in the last four years and have used many methods of removing the stringers and placing the backfill to bring the track to grade. Where hand labor was employed, the cost ran from $2.25 to $2.50 a track foot. In many cases, slow orders remained in effect for several months owing to continued settlement. Since using the crane and clamshell, however, we have found that in many cases the slow order can be raised after two or three days. Furthermore, our costs have been reduced to about $1.20 a lin. ft. of track.

Caps should be removed to allow the placing and thorough tamping of the earth around the piles. Good material that will remain stable should be used for the top of the embankment, and thoroughly packed to pre-

vent water pockets. In doing the work in this manner, the stringers are cut at alternate panel points into lengths of 26 to 28 ft. The rails are removed so that the stringers and caps can be lifted out by the crane. The backfill is then placed with the bucket and thoroughly tamped, after which the track is restored and surfaced.

By this mechanized method, we are able, under average conditions, to complete from 104 to 130 ft. of track a day with a gang of 14 men. In some places, where the embankment is wide enough to permit it to clear trains, a crawler-mounted tractor can be used to advantage.

Thinks Power Crane Most Effective

By A. FINNES

Master Carpenter, Great Northern, Minot, N. D.

Several methods are available. Formerly this was a hand job. At that time it was customary to dig a trench on each side of the stringers, raise the track enough to clear them and roll them out with cant hooks. After this was done, the track was filled and surfaced, but left high to provide for the settlement that invariably occurs, and trains were compelled to move under speed restrictions until settlement had practically ceased. On lines of heavy traffic, this is still an excellent method, except that the stringers should first be shifted toward the outside and the center of the track filled and tamped as this movement is made. Working progressively from one end of a structure, this method permits trains to proceed over the new roadbed as the work progresses.

Since power cranes became available, it has been common practice to disconnect the track at one end of the trestle, swing the loose end of the track clear of one line of stringers with the crane, also using this machine to remove the stringers. If equipped with a clamshell, this crane can be used to make the backfill. When one side is completed, the track is then swung to the other side and the remaining stringers are removed. This method has the advantage that fewer men are required and the crane can load the stringers at once. Furthermore, considerable time can be saved in surfacing the track by having the crane move back and forth to compact the fill while the work is in progress.

Removing the caps tears up the partly settled fill and causes considerable extra work, while the expense of removing them is usually greater than the salvage value of the timber so recovered.

Prefers to Remove by Hand

By W. J. HOWSE

Bridge and Building Foreman, New Orleans & Northeastern, Poplarville, Miss.

I prefer to do this work by hand since it does not involve the expense and delays incident to machinery and work trains. Regular track and bridge forces can readily accomplish the work in a safe manner by following the plan outlined. The first step is to insert track ties, or, if the trestle ties are to be retained, space them properly for regular track service. The earth is then removed from the outside of the stringers to the top of the caps and to a width that will permit easy passage of the stringers. As much as possible of this earth is placed in the center of the track and shovel tamped under the ties as the stringers are removed.

Following this, the bolts and fastenings are removed from the stringers. If the stringers form a three-ply chord, the outside stringers on both sides are then removed, the others remaining in place to care for traffic. At this point, the removal of all of the stringers is begun. As a matter of safety to traffic, it is preferable to remove an equal number of stringers from each side, thereby leaving the track exclusively on ballast to the end of that part of the structure not yet affected. This should be done in all cases where the trestle is too long to complete the removal without interrupting traffic. Obviously, to remove the stringers from one side only would create a hazard, since one side of the track would rest on a line of stringers and the other on the unsettled and, therefore, yielding earth and ballast. I do not advise the removal of the caps or bent bracing, since a new fill may continue to settle and creep for several years. The bents, being intact, serve to resist this movement. Furthermore, in the event of a slide, the bents can be used as the foundation for a temporary trestle.

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Digging in Ties

Does the practice of "digging in" ties when making renewals affect the riding qualities of the track? Does it have a detrimental effect on the roadbed? If so, how can these effects be minimized **?**

It Is Bad Practice to Dig Deep Trenches

By MAURICE DONAHOE

Division Engineer, Alton, Bloomington, Ill.

If not properly done, digging in ties will result in choppy riding track, since it loosens the bearing of the ties. If the track is not to be raised, the work should be done in such a manner as to remove as little ballast as practicable, so that the tie may have a support as nearly equal to that of the adjacent old ties as it can be given. Almost invariably the new tie is thicker than the one it replaces, even though it may have been carefully selected. For this reason some of the old bed must be removed or the track raised.

If the ballast is coarse, more of the bed must be removed, leaving a greater space to be filled by tamping. To provide the necessary ultimate bearing, it then becomes necessary to spring the rails in order to tamp the tie a little stiff to provide for the settlement that will invariably occur under the first few trains.

In other words, it is bad practice to dig deep trenches in the ballast to permit pulling the new tie into place, since this leaves too much space under the tie to be filled by tamping. Such ties will soon become loose, and will require several tampings before they reach the same bearing as those adjacent. Again, deep trenching is injurious to the roadbed because it results in water pockets which eventually hinder good drainage and may spread to become troublesome soft spots.

Practice Does Affect Riding Qualities

By W. RAMBO

Roadmaster, Missouri Pacific, St. Louis, Mo.

This practice does affect the riding qualities of the track, and where it is followed it is next to impossible to maintain smooth-riding track. It has a detrimental effect on the roadbed; in fact, it provides the quickest way I know of for ruining a good roadbed. I have no hesitation in saying that as a general practice the digging in of ties should not be permitted on any main-line track where smooth riding is essential.

If it becomes necessary, however, to spot in a few

ties to replace damaged, broken-end or decayed ties, the riding qualities of the track can be protected by tamping them snugly against the rail before the tie plates are applied. If the plates are then inserted, the new ties will have a firmer bearing and the choppy-riding conditions will be minimized.

All main-line track should be given a slight raise in connection with tie renewals and all unevenly spaced ties should be spaced. If this is done, the entire track structure will have a uniform bearing that can be obtained in no other manner. Furthermore, this method costs little, if any more than the digging-in method.

Does Not Favor Digging In

By J. J. EAGAN

Supervisor of Track, New York, Ontario & Western, Oneida, N. Y.

Where the ties are dug in year after year, the track becomes centerbound, the rail is likely to be kinked and surface bent, and where the old bed is disturbed, the new ties cannot be tamped as solidly as those that are not disturbed. The track should be raised enough to let the old ties out and the new ones in without disturbing the old bed.

A small section gang of three or four men should raise four rail lengths at a time. The ties that are to remain should then be tamped solidly from the end to about 12 in. inside of the rail. Pieces can be split off of the old ties and inserted as shims until the new ones are inserted and ready for tamping. Track treated in this way is more easily lined by a small gang because it has been loosened. It will settle uniformly and ride smoothly. A gang of four men and a foreman should renew 40 to 50 ties, or surface, line and gage eight rail lengths a day in cinder or gravel ballast.

This Method Is Practicable

By E. P. SAFFORD

Supervisor of Track, New York Central, Silver Creek, N. Y.

Where only a light surface is to be given or the low spots are to be touched up during the season, I believe that ties can best be "dug in" early in the season. There are several reasons why this plan is of advantage. The ballast works more freely at this time and cribbing can be done more rapidly in any kind of ballast. Spring weather is cooler and more ties can be installed per man. The new ties are used and the old ones disposed of early, so that the right of way is left clean and not littered with unused or discarded ties for most of the season.

The practice of not increasing the track forces until late in the spring or midsummer lends itself to this system of tie renewals. The smaller early-season gangs can have all or at least most of the tie renewals completed and surfacing or touching up can proceed without delay or interruption when the forces are augmented.

Digging in the ties does not necessarily make rough track if foremen are carefully instructed as to the proper methods and prompt and careful inspection is given to the work. Digging the trench deeper than is necessary to shift the old tie and slip it out and the new tie in should be avoided. The old bed should not be disturbed more than is necessary to level it off and permit free tamping of the new tie. Do not try to preserve the old bed intact, however, or the new tie may make a permanent humped spot, or it may remain loose because of insufficient space to permit good tamping. Cast the ballast back into the track with forks, not shovels, to avoid fouling the material used in tamping.

Where there are no tie plates, the spikes on the adjacent tie should be started, the rail pinched up and a spike or shim slipped under the rail while the new tie is being tamped, removing it as soon as this is done. If the track is tie plated, the spike should not be used, but the tie should be tamped and the tie plate inserted thereafter.

In the present situation, it is more than ever desirable to follow this method. With light section forces, probably throughout the season, little if any general surfacing can be done; in many cases only the low spots can be cared for. In this event, digging in is the only practicable method of insuring that the necessary tie renewals will be completed. I have followed this practice for many years under heavy main-line traffic and know that it can be done successfully.

[Additional answers opposed to the practice of digging in ties were received from E. Lane, extra-gang foreman, Missouri Pacific, and Henry Becker, section foreman, St. Louis-San Francisco. While the latter does not favor the practice, he admits that it is possible to follow this method and obtain satisfactory results. Other answers were received from Robert White, section foreman, Grand Trunk Western; L. D. Gardner, extra-gang foreman, St. Louis-San Francisco; W. E. Tillett, assistant foreman, Chesapeake & Ohio; and J. C. Hodge, section foreman, Texas & Pacific. These contributors consider that the method of tie renewal by digging in is practicable, but called attention to the ever-present danger of digging too deep and thereby destroying the foundation upon which the tie should rest.—Editor]

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Applying Prepared Roofing

What methods should be employed when applying prepared roofing to eliminate the tendency to wrinkle? Are these methods the same in the winter as in the summer **?**

Any Ductile Roofing Will Buckle Some

By A. L. SPARKS

Architect, Missouri-Kansas-Texas, St. Louis, Mo.

Any black roofing felt possessing proper ductility will expand and buckle somewhat when exposed to the action of the sun unless laid perfectly flat and cemented tight. Wrinkles may be discernible on roofs of greater pitch than 3 in. to the foot, while on roofs of 1/3 pitch they are very noticeable on single-ply roofing with laps of 2 or 3 in. and no intermediate fastenings. Heavier types of prepared roofing with slate, asbestos or other top surfacing do not usually wrinkle objectionably if applied in accordance with the manufacturers' instructions.

The simplest suggestion in these instructions is generally intended for a purpose and has a background of experience to justify it. An example is the instruction to unroll the roofing, cut it into suitable lengths and turn it upside down in the sun. This seems almost childishly simple, yet it is extremely important if a perfectly smooth roof is desired.

Our experience indicates that in using the lighter grades of prepared roofing on slopes greater than 6 in. to the foot, it is preferable to provide laps of 17 in. with 32-in. felts and of 19 in. for 36-in. widths, mopped together with lap cement and nailed with pyramid caps

in strips or with round tin caps. This provides a thickness that minimizes wrinkling.

Some manufacturers recommend for steep roofs that the felt be laid longitudinally with the slope, letting it roll from the ridge to the eaves. This permits the felt to stretch of its own weight and by starting the nailing at the top and working down, it is smoothed out somewhat by the workmen.

All of these suggestions are equally adapted for summer and winter, but in cold weather additional care must be observed in unrolling the felt. Before this is done, the rolls should be warmed sufficiently so that the roofing will lay flat and smooth; otherwise, it may crack or break.

Dampness May Cause Buckling

By FRANK R. JUDD

Engineer of Buildings, Illinois Central, Chicago

To avoid buckling of the roofing, roof surfaces should always be dry before the roofing is applied. These surfaces may be damp because the lumber was green when used, or it may have been seasoned or kiln dried and become wet before or after it was laid. Other causes of buckling of prepared roofing are the contraction and expansion of the roof boards, poor nailing which allows the roof boards to become loose, and moisture, which causes swelling in the roof boards or under roofing.

To take the curves out of prepared roofing which is applied in the summer, it should be unrolled and laid in the sun on a flat surface, such as the roof or a sidewalk, for some time prior to application. This allows the roofing to straighten out the curves due to rolling and to expand before it is applied.

In the winter, the roofing should be stored in a temperature of not less than 75 to 80 deg. for some time prior to application. It should also be laid out the same as for summer application to take out the curves and provide for proper expansion. If it is laid cold, it is likely to crack, and when the temperature rises in the spring and summer, a roof that has been laid in winter with cold material will expand and cause buckling.

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Deterioration in Masonry Culverts

What are the most common forms of deterioration in small stone and concrete box culverts? How should they be repaired ?

Most Failures Are in Plain-Concrete Boxes

By G. M. HELMIG

Bridge and Building Department, Missouri Pacific, Wynne, Ark.

Failures in concrete box culverts occur most often in the plain-concrete structures that were built from 1900 to 1905 before reinforced-concrete design was applied to this form of construction. Stone box culvert construction practically ceased with the advent of concrete as a structural material, so that those that remain are now relatively old. It is my observation that deterioration is usually the result of improper location, poor design and sometimes of poor materials. Failures occur most frequently in the roof because of insufficient strength. Another type of failure is caused by the collapse of the wing walls and culvert barrels as a result of improper location or lack of apron walls.

Repairs that can be made to the roof in either type depend on the condition of the walls and floor. Many roof failures can be cared for by replacing the roof with a rail-top slab, but where the shattering has impaired the walls, a complete replacement may be necessary. All culverts should have apron walls installed, or replaced if they have failed, and in many cases heavy rip-rap should be placed to prevent the undermining of the wing walls.

Most of the older culverts were installed before the period of investigation of drainage areas or in places where drainage conditions have changed. I have found many such culverts that were too small, and others that were more than adequate to handle the runoff. For these reasons, before repairs are made to a failing structure, it is desirable that the drainage area be investigated to determine what should be done with reference to the size of the water way.

Often Due to Poor Design and Construction

By JOHN L. VOGEL

Bridge Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

In general, deterioration in stone culverts is primarily the result of poor design and construction. Most stone box culverts are of small dimensions for this type of construction and failure occurs in the top stone slab, from the shaking loose of the walls because of inadequate thickness and bond and because the foundations are of improper width and depth. Usually, the stone box culvert does not afford sufficient room for making repairs and in most cases it is replaced with iron, steel or concrete pipe. Where room permits, the stone slab is often replaced with a reinforced concrete slab and the walls and foundations are reinforced by means of the cement gun.

Stone culverts of the arch type generally deteriorate in the roof because of improper size stone and poor bonding. Deterioration of walls and foundations can be attributed to poor bonding, improper thickness and poor foundation design. The walls and roof of this type generally consist of a face course of laid stones backed with small stones which were bonded with an inferior cement. In most cases, repairs have been made successfully by carefully removing all loose material and cleaning the joints by blowing out the fine material. The cement gun is then employed to fill all joints and openings, for in this way it is possible to cement the roof or walls into one unit. Where small stones have been used in the facing, it is generally necessary to wedge them by using steel spikes or dowels which can be used also to tie the heavy triangular mesh into place, which is used to reinforce the lining. This concrete lining is also placed by means of the cement gun, not less than 2 in. outside of the reinforcing being applied.

Concrete boxes or arches, when properly designed and constructed, require little attention beyond the regular inspections. We have been confronted, however, with a few cases of deterioration in concrete culverts, mainly as the result of using a poor quality of aggregate, which has caused spalling and cracking. Water has entered these cracks and the continued cycles of freezing and thawing have necessitated repairs. These repairs are made by carefully removing all poor material, cleaning the surface to be repaired, fastening dowels into the sound concrete and tying mesh reinforcing to them. The surface is then gone over with the cement gun, applying a minimum of 2 in. outside of the reinforcing. The thickness of the protection coat as well as the type of reinforcing used varies, however, with the different conditions that are encountered.

News of the Month . . .

Employment Drops in 1932

For the year 1932 the average number of employees of Class I railways, including large switching and terminal companies, was 1,048,568, as compared with 1,278,175 in 1931, a reduction of 17.96 per cent, according to the Interstate Commerce Commission. The total compensation for the year was $1,535,927,792, a decrease of $591,253,495, or 27.8 per cent, as compared with 1931.

Net Declines for First Two Months

For the first two months of 1933 the 149 remaining Class I railroads had a net railway operating income of $23,211,198, which was at the annual rate of return of 0.76 per cent on their property investment, as compared with a net of $32,866,741, or 1.08 per cent, in the first two months of 1932, according to reports compiled by the Bureau of Railway Economics. Operating revenues for the first two months totaled $437,633,202, compared with $534,881,748 for the same period in 1932, a decrease of 18.2 per cent. Operating expenses amounted to $352,039,086 as compared with $434,582,742 for the same two months of 1932, a decrease of 19 per cent.

Traffic for Second Quarter to Make Better Showing

Freight car loadings in the second quarter of 1933 will be 0.3 per cent less than the actual loadings in the same quarter of 1932, according to estimates compiled by the thirteen shippers' regional advisory boards. This estimate constitutes the most favorable forecast of carloadings that has been made for any quarter since the end of 1929. Of the 29 principal commodities covered in the forecast it is anticipated that five will show increases in loadings in the second quarter of 1933 as compared with the same period of 1932.

Mileage Books Becoming Popular

Reports from various sources indicate that the sale of mileage books by the railroads has been a means of stimulating travel by rail, although reports are not available from all the railroads. In February, the Chicago & North Western sold mileage books in the amount of $65,000 with a mileage totaling 2,500,000. Reports from agents show that a refrigerator concern in Detroit has instructed its men to purchase mileage books and use the railways instead of automobiles. A salesman, traveling 50,000 miles a year between Chicago and Omaha, Neb., and Texas points, and carrying 500 lb. of baggage, returned to rail travel, while a traveling salesman in Oak Park, Ill., is using the railroads for the first time. A patron at Dixon, Ill., expects to use 40 books a year, while at Huron, S. D., several salesmen exchanged their tickets for mileage books.

Railroads to Sell Visits to World's Fair

The railroads of the entire country have joined in a low rate plan for visitors to Chicago's Century of Progress Exposition, whereby a prospective visitor may, before he leaves home, purchase his hotel accommodations in Chicago, his transfer from the railroad station to his hotel and back again, tickets of admission to the Exposition, and a sight-seeing tour of the city. This plan has been arranged in conjunction with the American Express Company and the "visits" will be sold at every railroad station in the United States, as well as at the offices of the express company. They will allow stays in Chicago of from one day up to five days or more.

Cincinnati Union Terminal Opened for Service

The Cincinnati Union Terminal, which has been constructed at a cost of $41,000,000, was formally placed in service at Cincinnati, Ohio, on April 1. This terminal is jointly owned and used by all seven of the railroads that serve the city, including the Baltimore & Ohio; the Pennsylvania; the Cleveland, Cincinnati, Chicago & St. Louis; the Louisville & Nashville; the Norfolk & Western; the Southern, and the Chesapeake & Ohio. Three and one-half years were required to complete the construction of the terminal, which comprises, in addition to a passenger station serving all trains that enter and leave Cincinnati, railway auxiliary mail and express terminals, and engine and coach terminals.

World's Fair to Have Pageant of Transportation

A pageant of transportation, to be known as the Wings of a Century, will be displayed on the open-air stage opposite the Travel and Transport Building at the Century of Progress Exposition, which opens at Chicago on June 1. This pageant, which will be conducted by 200 people, will feature 12 locomotives, 70 horses, boats, stage coaches, early automobiles and an airplane. The 12 locomotives are replicas or originals of the "first" locomotives to haul trains on American railroads and include the Tom Thumb of the Baltimore & Ohio, built in 1829; the British-built John Bull of the Camden & Amboy, constructed in 1831 by George Stephenson; the De Witt Clinton of the New York Central, built in 1831; the Thomas Jefferson of the Winchester & Potomac (now a part of the B. & O.); the Mississippi of the Illinois Central, built in 1836; and the Seth Wilmarth of the Cumberland Valley (now a part of the Pennsylvania) built in 1851.

Rail Bill to Be Sent to Congress

President Franklin D. Roosevelt's plan for the appointment of a federal railroad co-ordinator to supervise the reduction of railroad operating expenses by the elimination of unnecessary services, etc., is expected to be submitted to Congress in the form of a bill early in May. Most recent reports indicate that the administration will recommend that the railroads be divided into three groups instead of seven as first reported, and that the provisions of the bill will be of an emergency character and effective for only a year, thus allowing time for the study of more permanent legislation in behalf of the railroads. It is generally expected that Joseph B. Eastman of the Interstate Commerce Commission will be appointed to the position of co-ordinator, although a formal announcement to this effect has not yet been made.

Williamson Protests Rail Taxes

In a statement issued on April 11, which stressed the "imperative need" for a change in taxation policy by the states with respect to the railroads, F. E. Williamson, president of the New York Central, said that his railroad "pays more taxes than any other single railroad in the country." Its taxes for 1932 amounted to $30,183,642," he declared. "In 1931 we performed nine per cent of the railroad business of the United States, as measured by operating revenues, and paid 10½ per cent of the taxes assessed against all the approximately 160 Class I railroads. Last year, with practically no federal income taxes, 10½ cents out of every dollar of operating revenue went to the government. A Canadian railroad, stretching entirely across the continent and owner of extensive lands, hotels and other properties, has tax bills which average only about $7,000,000 each year.

Motor Regulation in Three More States

The legislatures of three more states—North Dakota, Indiana and Maine—have passed legislation providing for the regulation of common and contract motor carriers and assessing such carriers for their use of public highways. In North Dakota three laws were passed, one providing for the supervision and regulation by the Board of Railroad Commissioners of the transportation of persons and property for compensation by motor vehicles, the second providing for the taxation of motor vehicles using the highways for commercial purposes, and the third fixing size and weight limitations for motor vehicles operating for hire. In Indiana six bills were passed, the principal ones being that providing for the regulation of contract motor carriers, that prescribing hours of service for drivers employed in highway transport and that assessing motor carriers for their use of the highways. In Maine the

recently enacted motor-carrier law requires common carrier trucks to secure certificates of convenience and necessity, gives the public utilities commission jurisdiction over the rates of motor carriers, and regulates the number of hours to be worked by motor-truck operators.

Introduce Low Passenger Fares in South

For the purpose of regaining lost passenger traffic, the Louisville & Nashville has announced fares of two cents a mile in coaches and three cents a mile in sleeping cars, these rates to be effective throughout the system. At the same time the Interstate Commerce Commission denied an application of the Southern for permission to put into effect for six months coach fares of 1½ cents a mile limited to points in competition with the L. & N. The Nashville, Chattanooga & St. Louis and the Mobile & Ohio made the reduction to two cents a mile at the same time as the L. & N. and the Central of Georgia later asked authority to make similar reductions on its lines.

President Considers Taxation of Water Carriers

A plan for reducing to a small extent the amount of the subsidy now received by water carriers by making them pay the cost incurred by the government for direct maintenance of channels and other aids to navigation is under consideration by President Roosevelt. With his advisers, the President is considering the possibility of imposing a very small tonnage tax on all craft using waterways made navigable and lighted at federal expense, for the purpose of determining if such a tax cannot be made to bring in revenues approximately equal to the annual expense for such maintenance. It has been calculated that the government spends about $60,000,000 a year for the maintenance of existing aids to navigation, such as lighthouses, buoys, dredging channels, ice-breaking, etc. In many other countries the water carriers contribute to such costs.

Net Income of Inland Waterways Shows Increase

The Inland Waterways Corporation, the government owned barge line operating on the Mississippi river and its tributaries, had a "net income" of $470,140 in 1932 as compared with $269,350 for 1931 according to the annual report of Major-General Thomas Q. Ashburn, chairman and president, to the Secretary of War. Total operating revenues for the year amounted to $6,131,346 as compared with $6,347,287 in 1931, while operating expenses were reduced to $5,607,365 from $5,965,739 in 1931. The total tonnage forwarded and received by all divisions was 1,572,869 as compared with 1,481,751 in 1931 and 1,758,244 in 1928, which was the peak year. General Ashburn, in his remarks accompanying the statistical report, says the year has been marked "by more severe and concentrated attacks upon the Inland Waterways Corporation than any year in its history" and thinks that the primary reason for this is that "the corporation is actually making a net profit."

Association News

Wood Preservers' Association

Arrangements are being made tentatively to hold the spring meeting of the Executive and other committees of the association, together with the Wood Preservation committee of the A. R. E. A., at the new Forest Products Laboratory, Madison, Wis., during the week of June 19-26.

Roadmasters' Association

Owing to the uncertainty regarding the advisability of holding a convention next September, the Executive committee has released the Stevens hotel, Chicago, from its reservation for the convention in order that it might contract with another association that desired to meet at this hotel on those dates. Tentative plans are being made for a meeting of the Executive committee in June to determine the action which should be taken regarding this year's convention.

Maintenance of Way Club of Chicago

The thirteenth annual dinner of the club was held at the Auditorium Hotel on April 19 with an attendance of 81 members and guests. The speaker of the evening was W. F. Thiehoff, general manager, eastern lines, of the Chicago, Burlington & Quincy, who addressed the group on Railroad Problems of Today. The following officers were chosen in the annual election: President, R. H. Carter, supervisor, Illinois Central; first vice-president, F. N. Hoyt, superintendent maintenance of way, Chicago Rapid Transit; second vice-president, V. R. Walling, principal assistant engineer, Chicago & Western Indiana; secretary-treasurer, W. S. Lacher, managing editor, Railway Engineering and Maintenance (re-elected); directors for two years, E. J. Brown, roadmaster, Chicago, Burlington & Quincy; George E. Johnson, representative, P. & M. Company; and Emil Rost, supervisor, Baltimore & Ohio Chicago Terminal.

American Railway Engineering Association

Members of the association are now receiving the revised edition of the Outline of Work and Personnel of Committees for 1933, which supersedes corresponding information published in the Bulletin of December, 1932. The principal change in personnel is the inclusion of the new Special Committee on Economics of Bridges and Trestles, and the selection of Lem Adams as chairman of the Committee on Economics of Railway Labor, as reported in last month's issue. However, the outstanding change is in the emphasis that has been given to certain of the subjects assigned a few of the committees, in line with the policy of the American Railway Engineering Association to foster organized research work. Subjects to which special attention is directed are marked with a capital "P," designating "preferred attention required," these subjects being as follows: Committee on Roadway—"Bearing power and other physical properties of soils, including effect upon roadbed"; Committee on Buildings—"Application of stainless and rust-resisting metals to building construction" and "Study the economic value of various basic and composite materials used in building construction and maintenance"; Committee on Iron and Steel Structures—"Use of alloy steels for structural purposes" and "Impact-railway bridges"; Special Committee on Stresses in Railroad Track—"Continue investigation of stresses in railroad track."

Railway Tie Association

The fifteenth annual convention of the Railway Tie Association will be held at the Jefferson Hotel, Richmond, Va., on May 10-11. The program will include the following features:

Wednesday

Report of Committee on Statistics, E. J. Stocking, sales manager, Hobbs-Western Company, St. Louis, chairman.

Report of Committee on Standard Plan for Adzing and Boring Ties, W. J. Burton, assistant to chief engineer, Missouri Pacific, St. Louis, chairman.

Address on "What the Buyer of Ties Expects from the Seller," by D. C. Curtis, chief purchasing officer, Chicago, Milwaukee, St. Paul & Pacific, Chicago.

Address on "For the Common Good of Tie Producer, Preserver and User," by R. S. Belcher, manager treating plants, Atchison, Topeka & Santa Fe, Topeka, Kan.

Address on "Balancing the Budget of Supply and Demand in Crossties," by Dr. Julius H. Parmelee, director of Bureau of Railway Economics, Washington, D. C.

Thursday

Report of Committee on Transportation, John Wright, Ayer & Lord Tie Company, Louisville, Ky., chairman.

Report of Committee on Utilizing Ties in Grade Proportions Normal to Woods Run Production and Standardizing Tie Lengths, A. R. Fathman, vice-president, Hobbs-Western Co., St. Louis, chairman.

Address on "Why Close Adherence to Standard Tie Specifications Pays from the Producers' Standpoint," by O. L. Massey, Ayer & Lord Tie Company, Memphis, Tenn.

Address on "Splitting of Ties," by R. R. Poux, chief treatment inspector, Erie, Cleveland, Ohio.

Address on "Advantages to Tie Producers from Advance Knowledge Regarding Future Purchases by Railroads," by J. J. Schlafly, president, Potosi Tie & Lumber Co., St. Louis, Mo.

Address on "Industrial Ties," by H. B. Kehoe, Gillis & Co., Chicago.

Address on "Ten Years of the Standard Tie Specifications," by E. E. Pershall, president, T. J. Moss Tie Co., St. Louis, Mo.

Election of officers and closing business.

The annual dinner will be held on Wednesday evening.

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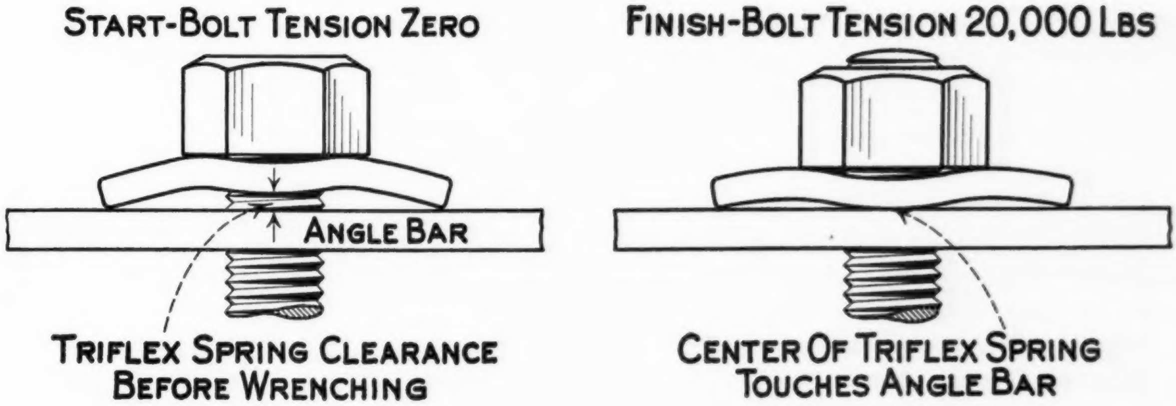

Verona Triflex Spring is designed and manufactured to provide a clearance between the center of the spring and face of the angle bar before bolt is tightened; approximately one complete turn of the nut increases the bolt tension from zero to twenty thousand pounds and brings the center of Verona Triflex in contact with the face of the angle bar, providing a simple and positive means for obtaining equal and proper tension in all bolts and by this means provides insurance against frozen joints and their attendant evils.

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A Device of High Reactive Spring Pressure

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Personal Mention

Engineering

W. J. Backes, chief engineer of the Boston & Maine, with headquarters at Boston, Mass., has been appointed also chief engineer of the Maine Central, succeeding **A. H. Morrill,** who has been appointed to assistant chief engineer of both roads, with headquarters as before at Portland, Me.

T. C. McCord, division engineer of the Kingsville division of the Gulf Coast Lines, with headquarters at Kingsville, Tex., has had his jurisdiction extended to include the DeQuincy division. **C. S. Colvin,** division engineer of the DeQuincy division, with headquarters at DeQuincy, La., has been appointed supervisor of bridges and buildings of the Kingsville and DeQuincy divisions, with headquarters at Kingsville.

F. M. Thomson, whose resignation as district engineer on the Missouri-Kansas-Texas, at Parsons, Kan., was noted in the April issue, was born on November 12, 1884, at Lockhart, Tex., and was

F. M. Thomson

educated at the University of Texas, from which he graduated in 1908. Prior to graduation, Mr. Thomson served a year on construction work with the Trinity & Brazos Valley (now the Burlington-Rock Island), and for a like period with the Oklahoma Central (now part of the Atchison, Topeka & Santa Fe). From June, 1908, to May, 1909, he was engineer in charge of construction of the Wichita Falls & Northwestern (now part of the M-K-T), and at the end of this period he left railroad service to engage in road work in Caldwell county, Tex. In 1909, Mr. Thomson entered the service of the Southern Pacific, where he was employed on maintenance work until 1917, when he went with the Katy as division engineer at Parsons, Kan., later being transferred to Sedalia, Mo. In 1919 he was appointed district engineer on the Wichita Falls & Northwestern at Wichita Falls, Tex., and in the following year he was appointed to the same position on the Katy at Muskogee, Okla., later being transferred to Denison, Tex., and thence to Parsons.

Following a readjustment of divisions on the Chicago, Rock Island & Pacific, in which the Pan Handle-Indian Territory division and the Oklahoma-Southern division were rearranged to form the Oklahoma and Southern divisions, **C. A. Richards,** division engineer of the Pan Handle-Indian Territory division, was appointed division engineer of the new Oklahoma division, with headquarters as before at El Reno, Okla. **S. L. McClanahan,** division engineer of the Oklahoma-Southern division, has been appointed division engineer of the new Southern division, with headquarters as before at Ft. Worth, Tex. Mr. McClanahan has also assumed the duties of roadmaster and master carpenter on the Southern division.

Track

F. H. Rothe, assistant engineer in the office of the chief engineer maintenance of way of the Western Region of the Pennsylvania, with headquarters at Chicago, has been appointed supervisor of track with headquarters at Colehour, Ill., succeeding **J. Slattery.**

C. M. Webb, roadmaster on the Southern division of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla., has been transferred to Enid, Okla., to succeed **G. M. Brum,** who has been assigned to other duties. As noted elsewhere in these columns, the duties of roadmaster on the Southern division have been assumed by **S. L. McClanahan,** division engineer.

Richard Coleman, assistant roadmaster on the Chicago & North Western, with headquarters at Chicago, has been promoted to roadmaster with headquarters at Lusk, Wyo., where he succeeds **L. Dippert,** who has been transferred to Missouri Valley, Iowa. Mr. Dippert succeeds **J. A. Roland,** who has retired. **J. P. Datesman** has been appointed assistant roadmaster at Chicago to succeed Mr. Coleman.

Oscar C. Benson, track supervisor on District No. 4 of the New Hampshire division of the Boston & Maine, with headquarters at Plymouth, N. H., has been transferred to District 1 of the Portland division, with headquarters at Worcester, Mass., to succeed **Martin King,** who has been retired after approximately 55 years of continuous service with the Boston & Maine. **J. W. Hicks,** assistant track supervisor, with headquarters at Concord, N. H., has been promoted to supervisor to succeed Mr. Benson. **P. J. Gogan,** extra crew foreman at Ayer, Mass., has been appointed assistant supervisor at Concord, succeeding Mr. Hicks.

H. B. Lincoln, whose appointment as general track inspector on the New York Central, at New York, was noted in the April issue, was born on January 4, 1889, at Syracuse, N. Y. He received his higher education at Syracuse University, and entered the employ of the New York Central as a laborer on July 22, 1905. From then until June 16, 1913, he held for various periods the positions of timekeeper, assistant foreman, rodman, and instrumentman, all while located at Syracuse, and on the latter date he was appointed assistant supervisor of track, with the same headquarters. On March 5, 1921, he became a transitman for a short period, and was then again appointed assistant track supervisor. On November 24, 1924, he was promoted to supervisor of track at Carthage, N. Y., and on August 1, 1929, was transferred to Weehawken, N. J., where he was located at the time of his recent promotion to general track inspector.

George G. Smart, supervisor of work equipment of the Great Northern, with headquarters at St. Paul, Minn., has been appointed general roadmaster of the Lines West of Williston, N. D., with headquarters at Seattle, Wash., succeeding **J. J. Hess,** who has retired. The position of supervisor of work equipment has been abolished and the duties of that position have been assumed by the general roadmasters.

Mr. Hess has served with various railroads in the west for more than 35 years. He was born on March 18, 1863, at Chicago and first entered railway service with the Gulf, Colorado & Santa Fe in Texas. He went with the Great Northern on June 1, 1897, as assistant roadmaster at Crookston, Minn., and then served as roadmaster at various points until September 30, 1903, when he resigned to

J. J. Hess

go with the Chicago, Rock Island & Pacific. While with the latter company he held the positions of trainmaster, general yardmaster and division roadmaster. From December 15, 1904, until April 18, 1906, he was with the St. Louis Southwestern as an assistant roadmaster, and on the latter date he returned to the Great Northern when he was made assistant engineer maintenance of way on August 10, 1913. In 1920 his title was changed to general roadmaster, which position he continued to hold at Seattle until his retirement.

Mr. Smart has been in railway service for 38 years. He was born on March 18, 1879, at Birmingham, England, and entered railway service in 1895 as a track-

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man on the Oregon-Washington Railroad & Navigation Co., being advanced to track foreman in 1898. Two years later Mr. Smart went with the Great Northern as a track foreman and extra gang foreman, being in 1906 advanced to district roadmaster at Everett, Wash. Three years later he was further promoted to division roadmaster, serving in this capacity at Spokane, Wash., Havre, Mont., and Everett, Wash., until 1920, when he was appointed general roadmaster of the Lines East with headquarters at St. Paul. In 1928 he was appointed supervisor of work equipment with the same headquarters, which position he was holding at the time of his recent appointment as general roadmaster.

Bridge and Building

E. B. Brown and **J. P. Yates,** supervisors of bridges and buildings on the Gulf Coast Lines, with headquarters at Kingsville, Tex., and DeQuincy, La., respectively, have been appointed assistant supervisors of bridges and buildings with the same headquarters.

Following a readjustment of divisions on the Chicago, Rock Island & Pacific, in which the Panhandle-Indian Territory division and the Oklahoma-Southern division were rearranged to form the Oklahoma and Southern divisions, **A. H. Sturdevant,** master carpenter of the Panhandle-Indian Territory division, with headquarters at El Reno, Okla., was appointed master carpenter of the new Oklahoma division. **J. P. Tillery,** master carpenter of the Oklahoma-Southern division, with headquarters at Ft. Worth, Tex., has been assigned to other duties, and the duties of the master carpenter of the new Southern division have been assumed by **S. L. McClanahan,** division engineer, as noted elsewhere in these columns.

J. A. Hamm, master carpenter of the Nebraska-Colorado division, with headquarters at Fairbury, Neb., has retired, and the duties of master carpenter have been assumed by **L. J. Hughes,** division engineer at Fairbury. **J. P. Pinkerton,** master carpenter of the Iowa-Minnesota division, with headquarters at Des Moines, Iowa, has been assigned to other duties, and **A. C. Bradley,** division engineer at Des Moines, has assumed his duties as master carpenter. **G. E. Brooks,** master carpenter of the Illinois division at Rock Island, Ill., has also been assigned to other duties and the duties of master carpenter of that division have been taken over by the division engineer, **F. W. Thompson,** at Rock Island.

Water Service

Paul M. LaBach, whose retirement on April 1, as engineer of water service of the Chicago, Rock Island & Pacific, with headquarters at Chicago, was noted in the April issue, was born on October 5, 1876, in New York City. He graduated from the United States Naval Academy and subsequently received a degree in civil engineering from the University of Cincinnati. He entered railway service in 1899 as an assistant engineer on construction on the Baltimore & Ohio, and in 1900 he went with the Chicago & Alton (now the Alton) as an assistant engineer. In 1902, Mr. LaBach entered private practice to engage in mining exploration work; two years later he re-entered railroad service as assistant engineer of construction on the Western Maryland. In 1906 he went to the Rock Island as an assistant engineer, remaining with this company for four years, at the end of which time he went with the United States War Department as an assistant engineer. Mr. LaBach returned to the Rock Island in 1911 as engineer of water service, which position he has continued to hold except for a period during the World War when he served as a major of engineers with the A. E. F. in France.

Paul M. LaBach

Obituary

Samuel A. Seely, division engineer on the Pennsylvania division of the New York Central at Jersey Shore, Pa., who died on February 26, as noted in the April issue, was born on May 22, 1877, at Jersey Shore, Pa., and started his railway career on December 1, 1900, as a clerk in the maintenance of way department at Jersey Shore. He served successively as a chainman and rodman and on May 1, 1902, he was made assistant general foreman in the track department, being appointed a transitman later in the same year. On June 1, 1904, he became a draftsman in the office of the engineer maintenance of way, at New York, and on June 1, 1906, was appointed assistant supervisor of bridges at Utica, N. Y. On May 1, 1907, he was made general foreman in the bridge department at Utica, and on March 15, 1910, he was promoted to supervisor of bridges and buildings on the Adirondack division, with headquarters, as before, at Utica. On March 1, 1917, he was promoted to assistant division engineer of the Adirondack division, at Utica, and on April 1, 1923, he was further promoted to division engineer at the same point. Mr. Seely was transferred to the Pennsylvania division, at Jersey Shore, on October 1, 1927, and held this position until the time of his death.

Supply Trade News

General

The Republic Steel Corporation has moved its Dallas, Tex., district sales office to 2322 Gulf building, Houston, Tex.

Standard Equipments, Inc., the manufacturer of the Evertite rail joint, has moved its headquarters office from 415 Lexington avenue to 70 East Forty-fifth street, New York.

The American Fork & Hoe Company, Cleveland, Ohio, has appointed **R. W. Jamison,** with office at 1222 Mission street, San Francisco, Cal., as sales agent for its Railway Appliances division products on the Pacific Coast.

Permanent Concrete Products, Inc., manufacturers of armored concrete crossing slabs, cribbing and other precast reinforced concrete products, Columbus, Ohio, has taken over the sale of these products which has previously been handled by the **Prendergast Company,** Marion, Ohio. **James R. Smith,** formerly associated with the Prendergast Company in the sale of these products, has become associated with Permanent Concrete Products, Inc., as vice-president in charge of sales, at Columbus.

Personal

Louis C. Bihler, assistant to the president and general traffic manager of the **Carnegie Steel Company,** has retired at his own request, effective April 30.

John Taliaferro, eastern sales manager of the **Atlantic Creosoting Company,** with headquarters in New York, has been promoted to vice-president in charge of the Savannah (Ga.) plant of this company. **J. C. Postell,** vice-president in charge of the Norfolk (Va.) plant, has been transferred to New York as vice-president in charge of plant operations and sales.

Thomas Aurelius, for many years head of the railroad steel sales department of the **Colorado Fuel & Iron Company,** Denver, Colo., has been elected a vice-president. Mr. Aurelius has been with the company for 31 years, having started work as a clerk in its wire mill in 1902 where he remained until 1907 when he was transferred to the sales department. For two years he was located at El Paso, Tex., and then was transferred to the Los Angeles, Cal., office. In 1910 Mr. Aurelius was again transferred to Pueblo, Colo., as superintendent of the wire mill, remaining in that position until 1917, when he went to Denver, as assistant to J. Chilberg, vice-president and general manager of sales. When Mr. Chilberg retired in 1921, Mr. Aurelius continued with the duties of that office and for several years he has had complete charge of the company's railroad steel sales.

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